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The effect of Forests on the circulation of water at the surface of continents.*

THE whole of this subject is exceedingly complicated, because it depends largely on a number of elements liable to vary widely within narrow limits of time and place. It is thus difficult to frame any rule of general application, and for the present the enquiry must be limited to defined localities in the hope that a large number of observations continued for a long series of years, and the progressive improvement of scientific methods, may eventually permit of their being combined into one harmonious whole.

The subject, "circulation of water at the surface of the soil," must be understood to include movements in the atmosphere, as well as in the soil and on its surface. The water in the soil may be more or less stagnant if the subsoil strata are level and impermeable.

It may now be considered a fact that large forests in the plains do indeed act like hill ranges as regards the precipitation of moisture.

Numerous experiments carried out by the Ecole Forestière of Nancy in the Forêt de Haye, by M. Fautrat in the forest of Halatte, by M. de Pous in the forest of Troucais, also in Germany, Austria, Russia, and even in India, show clearly that more water falls on forests than on the open lands adjoining. The difference is not very great, but may be 12 to 20 per cent.

The additional height due to the trees seldom exceeds 130 feet, and is often only half as much. The effect is nevertheless noticeable. Throughout the year, but especially during the moister seasons, the forests evolve a considerable amount of humidity into the atmosphere, and so render valuable assistance to the surrounding crops. If this were visible as fog, it would be seen that (apart

* Derived principally from an article by M. E. Henry in the *Revue des Eaux et Forêts*.

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from wind) each forest gives rise to a moist and cool layer extending, as shown by ballooning experience, as high as 4,500 feet. Resinous species liberate more water than broad-leaved ones. The tree crowns prevent a portion of the rain from reaching the ground at all. This quantity, instead of being carried away by the streams, is re-evaporated and passed on further in the atmosphere, and so does double duty. Sooner or later this mass of moist air meets a current at a different temperature, and the result may be that the same water falls a second time as rain in a different place. Hence a country possessing a fair share of forests can pursue agriculture under much more favourable conditions, and a country without forests, like the Deccan, Central Asia, and parts of America, is in a fair way to become a desert. Consequently the creation of forests in the plains is hardly less a measure of expediency than in the mountains, and the expediency is greater when the plains have naturally a light rainfall. Engineers, even of eminence, especially if interested in irrigation, will dispute this, but they do not know everything any more than foresters do, and the foresters' side is the side of safety. The question divides itself into two parts, plains forests and hill forests. In the former the benefits desired are largely atmospheric, in the latter they are rather in the direction of protecting the soil itself and of regulating the flow.

I.—PLAINS FORESTS.

What becomes of the atmospheric precipitations?—

- (a) part is retained and evaporated from the trees, &c.,
- (b) part is evaporated on or in the soil,
- (c) part flows away along the surface and streams,
- (d) part soaks into the soil up to saturation point,
- (e) part is absorbed by plants for their growth and transpiration,
- (f) the remainder sinks to lower levels, where it either forms subterranean reservoirs or percolates till it again comes to the surface as springs.

Calling R the total rainfall—

$$R = a + b + c + d + e + f.$$

On a level plain there is no surface flow, and the equation becomes—

$$f = R - (a + b + d + e).$$

In the simplest case, that of a perfectly bare plain, a, c, e become zero, and the equation is

$$f = R - (b + d).$$

Of all these factors the only one that can be measured with any-thing like accuracy, is the portion a evaporated off the trees. Even this factor, according to the Mariabrunn observations, is liable to very considerable errors of determination, since no two rain-gauges will give the same readings even under the same tree. It is necessary to employ a large number of rain-gauges, including

some embracing the trunks of the trees. Even employing 20 rain-gauges, totalling 10 square feet of opening, the probable error is at least 1 per cent. of the fall. The measurements should be made either (1) for each individual shower, (2) for a long series, (3) by grouping the showers according to their intensities.

It has been found in Europe that a broad-leaved forest prevents 1 to 3 tenths, and a conifer forest as much as 5-tenths, of the total precipitation from reaching the ground at all. But these figures hold good only for those localities where they were obtained. In countries where the rainfall is heavy and continuous, the forest soil in any case will be about as thoroughly watered as a bare soil.

All the other fractions, *b, c, d, e, f*, composing the total fall, are still very undetermined in forests and other lands alike, and they vary so much with every possible local difference that they are hardly likely ever to be capable of satisfactory measurement.

Reasoning from the known facts that, in spite of obstruction by the crowns, the forest soil is as well watered as the soil outside, and that the evaporation in a forest is much less as proved by the greater moisture of the surface soil; it was supposed that forests contributed more than anything else to the maintenance of subterranean supplies (level plains are still referred to). The results obtained in Russia, therefore, came as a great surprise. Soundings taken during the growing season (1st June to 1st September) inside and outside the forest of Chipoff (Government of Woronej) showed that the water level below the forest was some 32 feet lower than outside. In the Black forest (Government of Kherson) the level was some 12 to 16 feet lower. Presumably these figures are extremes for the following reasons—(1) the measurements were taken at the season when transpiration is greatest, (2) they were made in localities where the rainfall was only 12 inches in the year, where there was as a probable natural consequence of the dryness an almost complete lack of natural forest, and where consequently the forest would have to pump all it could in order to maintain itself. An increase of forest area would probably reduce the necessity for so much pumping by the roots. The experiment was repeated by M. Ototzky much farther north, under the 59th degree of latitude, in the Government of St. Petersburg, where the climate is cooler and moister and the rainfall averages 20 to 30 inches. The subterranean water is plentiful, yet again, the forest lowered the level, but this time only by 20 to 46 inches. In order to check the Russian results, an experiment has been started by the French forest officers in the forest of Mondon, near Lunéville. It is a level forest of about 5,000 acres situate on a low plateau formed of alluvial sand, gravel and pebbles. Eleven sound-holes were bored in 1899, six in the forest and five outside. The water level was found to be lower in the forest by 6 to 64 inches during the season of active growth. This result confirms the Russian observations, and accords

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with the known facts concerning the action of forests in drying up swamps and *stagnant* subsoil waters.

Nevertheless it would be a great error to jump to the conclusion that plains forests always and in all countries lower the level of subsoil waters. It has in fact been shown by Mr. Ribbentrop that near Trichinopoly wells, 6 to 10 feet deep inside the forest, held water throughout the dry season, whilst the river beds and wells, 15 feet deep outside, were dried up. Each locality must be studied under its own conditions. In a general way it may be said that plains forests render service of various kinds:—

- (1) They dry up swamps and malarious places, as, for instance, the Landes, the Sologne, the Pontine marshes, and many others.
- (2) They suck up from great depths water which is otherwise not utilisable, and cause it to again circulate in the atmosphere where it forms fresh rain.
- (3) They do not injure the springs, since there are none in level plains where man is obliged to have recourse to irrigation. They may lower the subsoil water level to a degree which is seldom serious if the rainfall is enough to be of any practical use to the crops.
- (4) They cool and moisten the air and render showers more frequent during the growing season.

II.—MOUNTAIN FORESTS.

A rainfall chart bears a great general resemblance to a contour or relief map, the more the hills, the more the rain. In reality the rainfall is more complicated. All mountain chains show rain maxima, and these maxima are very generally proportionate to the elevation. There is more rain at 6,000 feet than at 4,000, more at 4,000 than at 2,000, and so on. Even small elevations suffice to attract an appreciable maximum. Wooded mountains are still more effective, especially in the summer months. Mountain forests are mostly coniferous, and conifers exercise an influence even more powerful than that of broad-leaved forests. A forest is always covered by a great layer of moisture which is there none the less, though it is not visible as mist. Whence comes all this vapour? Is it due to evaporation from the leaves, or is it produced by some action of the millions of points of the pine needles? Science cannot tell, but the effect is certainly not due to transpiration alone. Transpiration is indeed less active in conifers than in broad-leaved species, and it would consequently be expected that the former would give rise to a smaller layer of invisible mist than the latter, but the contrary is the case. The cause must therefore be sought in the soil or in some other unknown factor. One cause may be the soil, but another is surely to be found in the greater proportion of the rainfall that is intercepted by conifer crowns. It was shown in France that in 1876 the conifer forests intercepted and restored to the atmosphere over 100,000 cubic feet

more water per acre than the broad-leaved forests. Other years have given even greater differences, and there are no means of making exact measurements, but there is no doubt that wooded mountains attract more rain than bare ones.

In all Europe, Spain is the country that gets least rain. Notwithstanding the great mountain chains running up to 10,500 feet in Grenada, Murcia, &c., the rainfall of July and August is not half an inch. If these mountains were wooded instead of being absolutely bare, the south-east of Spain would not suffer so much from drought, and the country would not have had to deplore the disastrous floods produced in Murcia by the Segura. Spain is at last awake to the fact, and has undertaken a series of reboisement works, an account of which was read at the International Congress of Sylviculture of 1900 in Paris by M. Ricardio Codorniz, Chief Engineer thereof. There is plenty of moisture in the sea breezes, but nothing to condense it on to the hot mountains. In the mountains the rainfall is divisible into the same kinds of fractions as in the plains, with this difference, that the proportion of surface flow, being zero in the plain, becomes considerable on the mountain. The quantities *a*, *b*, *d*, *e* may first be examined. The quantity *a* has not been directly determined, and the plains results cannot be quite applicable on account of the preponderance of snow, and the great differences of intensity and distribution. The evaporation from the soil surface *b* must be less than in the plains, because the temperature becomes lower as the altitude increases. For the same reason the water fixed in or evaporated by the plants, *e*, is also less, as may be verified by the proportion of ashes. The growing season is shorter and the heat less great. Consequently the transpiration is less and the quantity of organic matter formed annually per acre is smaller. At Aschaffenburg (400 feet) a thousand beech leaves will cover about 35 square feet, while at 4,000ft., near the upper limit of the species, the same number of leaves will only cover about 9 square feet. The percentage of ashes and the total weight are also less, being 4.03 per cent. for beech and 3.58 per cent. for spruce, against 9.91 and 10.19 respectively. Even the grass at high levels contains one-half less ash than in the valleys.

On level spots in the mountains, whether forest, grass or bare, there is a decidedly greater amount of moisture in the soil than in the plains under similar circumstances. There is more rainfall and the snow lies longer. The amounts evaporated directly, or utilised by plants, are also less. It is well known that high plateaux, &c., are often swampy or peaty. But level spots are the exception, mountains consisting principally of more or less steep slopes where surface flow is an important factor. In fact, the surface flow is the great characteristic of unlevel countries and constitutes the great difference between these and the plains. There are numerous examples continually coming to light, showing the excellent effect produced by forests on the volume, the regularity,

and the maintenance of springs. This is perhaps the place to mention a certain nala in Lachiwala forest, coming down from Nagsidh hill. Up to 1896 this nala carried running water in November-December. In later years it has always been dry by the end of October. The dryness is perhaps not permanent for the future, but it may be due to fellings that have been made on the slopes of Nagsidh. Nobody now denies the beneficent action of forests from a quadruple point of view, *viz.*, the increase of rainfall, the protection of the soil from erosion, the more regular flow and diminution of floods, and the maintenance and steady flow of springs.

How is it possible to explain the apparent contradiction between this last point and the result of the previously mentioned experiments in plains forests, where it was shown that the level of subsoil waters was somewhat lowered? Is it possible that the forest acts in opposite ways in different localities? Before answering this question certain well-known facts may be considered. Suppose a slope at 45°, wooded on its left half and bare or grassy on the right half. In winter both halves are covered with snow, more thickly and evenly so in the forest since there are no avalanches and the wind cannot sweep up or evaporate so much. The spring brings a rapid thaw. On the bare slope where nothing hinders the access of warm air the melting will proceed quickly and the greater part of the resulting water will disappear at once by the streams. It is well known that in bare or grass mountains the melting of the winter snows causes great and sudden floods like the disasters of 1856. The quantity of water soaking into the soil depends, among other things, on the length of time during which the water remains in contact with the soil. This time itself depends partly on the duration of the rain (or melting snow), and partly on the steepness of the slope. A very steep slope removes the water quickly, so that there is little time left for absorption. Hence steep slopes dry up very quickly after rain, more especially if they are not wooded. On the wooded half of the above supposed slope, the melting will be quite slow, taking a fortnight or a month longer. Thus, even without any low vegetation, the surface flow will be much slower, and more prolonged, with a corresponding decrease in flooded streams. But the forest soil always possesses a covering of dead leaves and humus acting like a sponge, able to absorb and hold as much as two or three times its own weight of water which it only parts with drop by drop. The soil below is protected from evaporation and sucks it all in to the great benefit of subsoil supplies. The effect is still further increased by the then dormant condition of vegetation, which has no need to absorb any water at that time. The same thing happens during the heavy summer rains, except that the trees this time appropriate a certain share for their own use. If there is actually any water flowing along the surface it is much impeded by the network of roots, stalks,

and obstacles of all kinds, so that a given flowing drop has every chance of finding a spot able to absorb it, or a small crevice by which it may get underground. The final result is a great diminution or complete stoppage of surface flow. It is true that during excessive rains or melting of snows, the forest cannot always prevent floods, but in such cases the rise is much less sudden and severe than it might have been, and is due more to enlarged springs and less to erosive surface action.

According to M. Imbeaux, State Engineer to the important Municipality of Nancy, the fraction representing the surface flow due to very heavy rains may be calculated from the rise in the streams affected. He found that in the exceptional floods of the duration on the 27th and 28th October, 1882, the 26th, 27th October 1886, and the 8th, 11th November 1886, the fraction at Mirabeau was .33, .39 and .42, or over a third of the total fall. For less violent rains the fractions were .27, .22 and .18, in accordance with the general law according to which the surface flow follows the intensity of the rain. At the junction with the Rhone, the figures were very similar but smaller. For the Danube at Vienna, M. Landa found 42.1 per cent. from 28th July to 14th August 1897. It is clear that for a given rainfall the surface flow will be greater as the soil itself becomes steeper and more impermeable or rocky, but the covering of the soil has a powerful influence in all cases.

On this point M. Imbeaux says:—"The re-forestation and returfing of bare mountains at high altitudes are, and have in France been long known to be, among the most effectual methods possible for checking excessive surface flow and its consequent disasters. During the first half of the century the United States of America forgot or disregarded all this, and destroyed their primeval forests at a wholesale rate. They have now seen with their own eyes how their former steady (and regular streams have become transformed into torrents, raging down so long as it rains, and dry for the rest of the year. The matter is proved beyond dispute." Thus wherever man has to fear floods, he should plant forests as his best of all protections. They will give him important other advantages into the bargain as already shown.

The figures given above refer to large basins where the slopes are partly bare, partly cultivated, and partly forest or grass. Figures relating to basins of one kind exclusively would be of value. Since 1860, M.M. Jeandel, Cantegril, and Bellaud have been making comparisons between neighbouring basins, and they find the tendency to floods to be diminished by one-half in the wooded basins. Their work is not perfect, but it is the best available, the researches of M. Belgrand being worthless on account of defective conditions. The Swiss Forest Research Station is now beginning experiments in this direction in two adjoining basins, one wooded, the other almost without wood. Many rain-gauges

will give the true rainfall, and the outflow will be measured in the streams with precision by means of weirs.

The quantity saved from flowing away on the surface can be estimated from the springs, but only approximately. There are many instances of springs drying up or decreasing in quantity and regularity through the clearing of their basins, as also of springs being brought to life again by the growth of forest. There are lists of these in specialist publications, but a few more may here be cited, because they are recent, perhaps little known, and warranted by competent observers. M. Crahay, Inspector of Forests at Brussels, in 1898, quoted instances of the sources of the Sure at Planchimont, &c. :—

“Since the spruce plantation of 35 years back, the flow has become more regular. One which used to be dry all the summer is now never dry, and is now about 220 feet higher up than it used to be. At Bois le Français, in the commune of Villers-devant-Orval, after the clearance of an old coppice with standards, two springs dried up. The place where the water came out, and the little bed it ran in, are still to be seen.”

At the International Congress of Sylviculture, held at Paris in 1900, M. Servier, a landowner at Lamure sur Azergues (Rhône), made an interesting communication “On the hydrostatic phenomena following the planting of conifers.” The soil is sandy. It was, till recently, almost devoid of wood, a fact tending towards floods and torrents. Wherever a small clump of wood remained, the spot was generally marked by a spring. There is a spring on the western edge of one of these clumps. Every time the coppice is felled the spring diminishes, and as the coppice grows, the spring recovers its volume. M. Bargmann quotes two springs in the communal forest of Storkensohn (valley of Saint Amarin, near Urbès) which dried up when the forest above it was felled, but a new spring appeared about 500 feet lower altitude where no fellings had been made. “It is easy to see that the disappearance of forest completely changes the conditions of evaporation and surface flow. Both are increased by disforestation.” The only conclusion possible is, that the moisture lost by increased evaporation and quicker surface flow is much greater than the gain by cessation of root-suction.

It was mentioned just now that the portion saved from surface flow could only be roughly estimated from the springs. This is because all the water saved does not re-appear in springs. Some of it goes as deep as 1,500 to 3,000 feet to form subterranean reservoirs which are available for artesian wells; for instance, the artesian wells of Paris, the supply for which sinks in along the outcrop of the greensand in the basin of the Meuse. Elsewhere the water may sink in till it finds an outlet into some ocean. In some cases, the subterranean water losing its outlet in one basin may work across to another valley altogether, and increase the springs there. Finally, and most important, the soil itself must

be considered as a great sponge, the degree of saturation of which varies irregularly according to the abundance and persistence of the rains. If a year begins with a low level of saturation and subterranean waters, and ends with a higher level or degree of saturation, it is evident that the surface flow of that year must have been less than normal, much of the normal surface flow having been absorbed to the benefit of the subterranean supply. Hence, the relation between the actual rainfall and the surface flow in that year will be disturbed, being less than would have been the case if the year had begun with full resources. In the one case the relation will be less than the average, in the other case more. In the one case the budget begins with an overdraft which has to be met, in the other there has been something "brought over."

As the subterranean waters are beyond the reach of all measurement, it can only be judged that when the springs run full, the soil is full, and when the springs diminish, the subterranean reserves are low. So long as the springs remain normal, there is equilibrium. The time elapsing between the disappearance of the water underground and its re-appearance in the springs is very variable. In coarse or fissured soils the springs begin visibly to increase almost as soon as the rain begins. In very compact soils, and when the distance of infiltration is long, the process lasts for years. In the first class of cases just mentioned there may be damage. On steep slopes and in soft loose soils the streams dig deep beds and cut away banks whose removal causes landslips. Good earth is continually being carried away and raw mineral soil exposed. Needless to dilate further on this point. Here, again, the forest is the natural remedy. Across all these little streams living weirs are constructed. These are formed of willow cuttings which soon strike root and produce vigorous shoots. A stout fence is thus produced which rises as the river bed itself rises, forming a filter through which all the water indeed passes, but its evil impetuosity is ended. In torrent beds of great width trees are planted, such is the alder forest which is so jealously maintained in the bed of the Veneon, where it joins the Romanche. The forest checks the violence of the flow, and compels the deposit of sediment which would otherwise go further down and raise still more the already too elevated bed of the Romanche; these are the best kinds of dams, they cost little to construct and nothing for maintenance. The method is not always available. But it is not adopted nearly so often as it might be. It is only through the action of forests that the rivers arrive at the sea in a steady and respectable manner, having throughout their courses rendered the highest possible services to man, to animals and to plants, by springs, by percolation, by irrigation, by furnishing power, by providing the means of transport, &c.

**Review of Forest Administration in British India for the
year 1898-99.**

BY B. RIBBENTROP, C.I.E.,

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THIS review, though necessarily somewhat belated, is always of interest, since besides giving a concise summary of the year's work it contains a great many useful statistics, the more important of which we as usual quote below.

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Areas and Settlements.—The areas of all forest lands, under the management of the Forest Department, are given in the following statement:—

Provinces.	FOREST AREA IN SQUARE MILES.					Proportion of forests to whole area of province.
	Area in square miles.	Reserved.	Protected.	Unclassified State.	TOTAL.	
						Percent.
Bengal	153,149	5,881	3,816	4,033	13,730	8.96
North-Western Provinces and Oudh.	106,149	4,005	30	43	4,078	3.84
Punjab	110,786	2,892	2,473	2,119	7,484	6.75
Burma (Lower)	83,557	7,679	...	...	7,679	9.19
Burma (Upper)	77,210	7,988	...	...	7,988	10.34
Central Provinces	86,451	18,930	...	185	19,115	22.11
Assam	41,380	3,537	...	16,673	20,210	48.84
Coorg	1,582	238	657	...	895	56.57
Ajmer-Merwara	2,646	139	...	10	149	5.62
Baluchistan	...	205	...	...	205	...
Andamans...	2,000	156	...	1,796	1,952	97.60
Total	664,909	51,650	6,976	24,859	83,485	12.52
Berar	17,707	4,175	...	...	4,175	23.56
Total Bengal Presidency	682,616	55,825	6,976	24,859	87,660	12.81
" Madras "	141,259	14,888	...	4,706	19,594	13.87
" Bombay "	823,048	13,435	1,507	...	14,942	12.14
GRAND TOTAL	646,923	84,148	8,483	29,565	122,196	12.88

The total area was increased during the year by 2,425 square miles. Under reserved forest there was an increase of 2,794 square miles, which occurred chiefly in Madras, Burma and the Punjab. The reclassification of forests in the Central Provinces led to the disforestation of a large area for cultivation purposes, and in Madras considerable areas were abandoned. The increase in the Punjab is only of a temporary nature, as it is intended to bring the greater part of the new area under cultivation when irrigation becomes possible.

Demarcation.—The statistics of demarcation are shown as follows:—

	Miles.
Length of artificial boundaries	106,264
" " boundaries not demarcated	30,880
" " " naturally demarcated and not requiring marks...	15,870
Total	147,104

The expenditure on repairs to boundary marks was Rs.48,448 and on new work Rs.49,637.

Surveys.—"During 1898-99, forest survey operations were conducted in Madras by a double party, and in Bombay and Burma by single parties of the Survey of India Department, and No. 18 party also completed the survey of some forest tracts in the Punjab.

"The operations of the Forest Survey Branch were confined to the Central Provinces, the Punjab, Burma and Oudh. From the 1st April of the year under review, No. 20 party of the Survey of India Department, which is employed in Burma, was transferred to the administrative charge of the Superintendent, Forest Surveys. The total outturn of forest surveys, executed on various scales during the year, amounts to 5,217 square miles, of which 2,257 square miles, on the 4 and 16 inch scales, were surveyed by the Forest Survey Branch for forest purposes, as well as an additional area of 953 square miles, on the 1-inch scale, to complete the standard topographical maps of the Chamba State. The areas surveyed by the Forest Survey Branch for forest purposes shows an increase of 520 square miles over that completed last year, and there is also a marked increase of forest areas reported as surveyed by the Survey of India Department."

The total expenditure on account of forest surveys in India was Rs.4,59,647, against Rs.5,03,198 in the year 1897-98. Excluding the 1-inch areas, which were surveyed purely for topographical purposes, 50,331 square miles have up to the year under review been surveyed on various scales for forest purposes.

Working-plans.—"Satisfactory progress was made in the preparation of working-plans in the Bengal Presidency, where sixteen plans, dealing with 3,939 square miles, received sanction by Local Governments, as compared with seventeen plans for an area of 2,964 square miles in 1897-98. In the Central Provinces the progress made was again excellent, and working-plans have now been sanctioned for a total area of 6,542 square miles, or 34 per cent. of the total forest area; the plans, however, in these provinces deal with large areas covered with a similar forest growth, and involve work of a less intricate nature than is usually the case in most of the other provinces.

"In the North-Western Provinces and Oudh, where 85 per cent. of the total forest area is under working-plans, little remains to be done beyond the revision of existing plans as they fall due. In Burma three plans, dealing with 297 square miles, were sanctioned, and a good deal of preparatory work was carried out, but a vast amount of work remains to be done, especially in Upper Burma.

"At the close of the year, out of a total forest area of 87,660 square miles in the Bengal Presidency, 20,348 square miles, or 23 per cent., were under sanctioned working-plans.

"Little progress was made in Madras during the year, but, now that the time of Forest Officers will be less occupied by

settlement work than in the past, it is hoped that the preparation of working-plans will proceed more rapidly. That there is an enormous amount of work to be done is shown by the fact of there being still no less than 17,884 square miles to be dealt with.

"In Bombay working-plans have been sanctioned for only 1,319 square miles out of a total forest area of 14,942 square miles. Many other plans covering large areas are shown as completed or under preparation; but it is not clear from the reports how many of them are scientific working-plans and how many deal with areas simply divided into coupes on the ground, but for which no regular working-plans have been yet prepared or commenced."

The areas brought under the control of sanctioned working-plans up to the 30th June, 1897, in the provinces of the Bengal Presidency, were as follows:—

Province,	Forest area in square miles.	Area for which working-plans prepared and sanctioned up to 30th June.	Proportion of forest area under sanc- tioned working- plans.
		Square miles.	Per cent.
Bengal	13,730	4,437	32
North-Western Provinces and Oudh.	4,078	3,446	84.5
Punjab	7,484	2,504	33.5
Burma (Lower)	7,679	1,761	23
Burma (Upper)	7,988	116	1.5
Central Provinces	19,115	6,542	34
Assam	20,210	533	2.5
Coorg	895	145	16
Ajmer-Merwara	145	139	93
Baluchistan	205	...	...
Andamans	1,952	...	...
Berar	4,175	725	17.5
Total	87,660	20,348	23

Communications and Buildings.—The total amount spent was—

	New.	Repairs.	Total.
	Rs.	Rs.	Rs.
Roads	58,178	89,415	1,47,593
Buildings	1,54,357	95,358	2,49,715
		Total ...	3,97,308

Madras heads the list with Rs.88,023 ; next comes the North-Western Provinces and Oudh, with Rs.76,230. Burma spent Rs.47,636, Bombay Rs.33,464, the Punjab Rs.25,275, Assam Rs.27,555 and the Central Provinces Rs.15,741.

General Protection.—The following table gives the number of cases of forest offences tried by the Courts, or compounded by Forest Officers during the year :—

Presidency.	Number of cases disposed of by the Courts.	Number of cases compounded.	Total.
Bengal	3,128	12,162	15,290
Madras	5,697	10,070	15,767
Bombay... ..	1,735	7,192	8,914
GRAND TOTAL ...	10,610	29,361	39,971

These offences are classified in accordance with their character as follows :—

Injury to fire-protected forests by fire	3,887
Unauthorized felling or appropriation of wood and minor forest produce	25,231
Grazing without permission in tracts in which grazing is prohibited... ..	16,452
Other offences	3,239
Total	48,859

“ As is usually the case, the majority of offences were those of unauthorized felling or theft of forest produce, 63 per cent. of which were compounded. The total number of cases of injury to the forests by fire was 3,887, of which Bombay was responsible for no less than 2,425, the Central Provinces for 578, and the Punjab for 279. It is to be regretted that no improvement in the detection of fire cases took place, 80 per cent. remaining undetected, or the same as in the previous year, but in Bombay out of 2,425 such cases 2,168 or 89 per cent. remained undetected.”

Protection from fire.—“ There was an increase of 561 square miles in the forest area over which special measures of protection against fire were taken, the total area standing at 32,265 square miles at the close of the year under review. The results were slightly better than in the previous year, and may be considered satisfactory, as 91.41 per cent. of the total area was successfully protected, the cost being Rs.3,13,002 or Rs.10½ per square mile protected. The details of the work done in the various provinces are fully shown in the following table :—

Province	AREA IN SQUARE MILES		Proportion of failures to area attempted.	Cost	Proportion of area under fire-protection to total area of forests (leased forests included).
	At-tempted.	Pro- tected.		Per square mile protec- ted.	
			Per cent.	Rs.	Per cent.
Bengal	2,080	2,052	1.77	6½	15.21
North-Western Provinces and Oudh.	3,081	2,956	4.05	20½	75.55
Punjab	356	335	5.90	18	4.76
Burma (Lower)	1,158	1,022	11.74	51	15.08
Burma (Upper)	1,999	1,425	28.71	22½	25.02
Central Provinces	5,460	5,072	7.11	9½	28.54
Assam	1,204	1,202	0.16	7½	5.95
Coorg	204	195	4.41	30½	22.79
Ajmer-Merwara	139	139	...	2	100
Total	15,690	14,398	8.23	15½	19.28
Berar	1,473	1,421	3.53	9½	35.28
Total Bengal Presidency	17,163	15,819	7.83	15½	20.73
" Madras	5,126	4,941	3.61	7	26.16
" Bombay "	9,976	8,732	12.47	4½	71.87
GRAND TOTAL	32,265	29,492	8.59	10½	26.88

Regulation of grazing.—The forest areas opened and closed to grazing were as follows :—

Province.	Total Forest area.	Area closed to all animals.	Area closed to browsers only.
	Sq. miles.	Sq. miles.	Sq. miles.
Bengal Presidency	87,660	29,928	9,437
Madras "	19,594	1,824	2,054
Bombay "	14,942	2,750	5,503
Total	122,196	34,502	17,000

The amount of revenue realised from grazing was—Bengal, Rs.6,76,205; Madras, Rs.4,09,291; Bombay, Rs.3,08,957: total Rs.13,94,453 or Rs.65,000 in excess of the previous year; the

increase being in all provinces, except Bengal, the Punjab, Coorg and Berar. The revenue foregone under grazing concessions is estimated to amount to Rs.13,43,377 in all provinces.

Reproduction and Sylviculture.—But little information is afforded under this head. The area of plantations at the close of the year, and the amounts expended on plantations and cultural operations during the year, were as follows:—

Province.	AREA AT CLOSE OF THE YEAR.			EXPENDITURE.		
	Regular plantations.	Taungyas.	Total.	Plantations.	Cultural operations.	Total.
	Acres.	Acres.	Acres.	Rs.	Rs.	Rs.
Bengal	2,872	...	2,872	632	7,736	...
North-Western Provinces and Oudh.	3,119	...	3,119	914	3,175	...
Punjab	696	...	696	913	4,825	...
Burma (Lower) ...	3,536	43,933	47,469	63,894	4,938	...
Burma (Upper) ...	132	1,343	1,475	4,054	1,190	...
Central Provinces ...	...	...	...	...	163	...
Assam	2,115	85	2,200	13,167	31	...
Coorg	2,219½	527	2,746	1,973	497	...
Ajmer-Merwara ...	...	...	...	...	746	...
Baluchistan	30	...	30	20	12	...
Andamans	333	...	333	305	231	...
Berar	655	...	655	...	1,179	...
Madras Presidency ...	30,678	...	30,678	27,557	9,926	...
Bombay "	16,526	...	16,526	1,0357	11,499	...
GRAND TOTAL ...	62,911½	45,888	108,799	1,18,786	46,147	1,64,933

The net increase in the area of plantations was 6,045 acres.

Outturn.—The total outturn of all forests under the control of the Forest Department in timber, fuel, bamboos and minor forest produce, is exhibited in the following table :—

Province.	Timber. c. ft.	Fuel. c. ft.	Bamboos. No.	Minor produce, including grazing. Rs.
Bengal ...	6,146,756	16,420,656	15,965,808	1,55,795
N. W. P. and Oudh ...	3,149,446	7,228,661	12,032,085	1,78,117
Punjab ...	1,931,940	6,003,629	843,936	1,74,548
Burma (Lower) ...	11,454,818	7,364,901	29,746,000	1,01,325
Burma (Upper) ...	17,245,435	4,631,421	25,918,000	1,83,894
Central Provinces ...	1,759,760	12,528,452	19,900,719	4,51,793
Assam ...	7,446,701	6,005,431	24,427,831	74,728
Coorg ...	403,506	101,518	205,610	18,610
Ajmer-Merwara ...	2,031	274,123	9,056	7,875
Baluchistan ...	5,107	464,948	...	930
Andamans ...	267,649	1,169,564	82,461	1,905
Berar ...	474,461	1,442,364	2,717,734	2,27,355
Total Bengal Presidency	50,287,610	63,635,608	131,849,276	15,76,875
„ Madras „	2,621,012	13,119,020	25,932,677	9,44,186
„ Bombay „	3,753,974	32,777,092	7,017,887	5,83,210
GRAND TOTAL ...	56,662,596	109,531,717	164,799,840	31,04,271

Financial Results.—“The gross revenue realised during the financial year amounted to Rs.1,90,38,000, as against an average revenue for the last five years of Rs.1,74,50,000, the net revenue was Rs.90,04,000, as against a quinquennial average of Rs.77,93,000. This is satisfactory and, but for the fact that owing chiefly to famine and plague, the revenues of Bombay, the Central Provinces, and Madras have seriously declined of late years, the gross and net revenue would have stood well above two and one crores of rupees respectively.

“The revenue and expenditure for the year under review, and for the quinquennial periods since 1872-73, are given below :—

Quinquennial periods.	Gross revenue.	Expenditure.	Proportion of expenditure to gross revenue.
	Rs.	Rs.	Per cent.
1872-73 to 1876-77 ...	65,38,373	44,09,179	67
1877-78 „ 1881-82 ...	73,80,431	49,42,512	67
1882-83 „ 1886-87 ...	1,06,78,807	68,31,284	64
1887-88 „ 1891-92 ...	1,42,46,891	80,69,590	56
1892-93 „ 1896-97 ...	1,71,60,426	93,99,796	55
1898-99 ...	1,90,38,520	1,00,33,920	53

“The forest resources of Upper Burma, which was added by conquest since the creation of the Indian Forest Department, is responsible for a gross revenue of Rs.41,27,000 and yielded a net

revenue of Rs.32,31,000 or 75·4 per cent. This is quite exceptional and only possible when the material is almost entirely exploited at the cost of the purchaser. Apart from this the proportion of surplus to gross revenue amounted in the Bengal Presidency to 54·9 per cent."

"The following table compares the revenue and surplus in each province :—

Province,	Revenue, 1898-99.	Surplus, 1898-99.	Deficit, 1898-99.	Proportion of surplus to gross revenue.	Net revenue per square mile of land under control of Forest Department.
	Rs.	Rs.	Rs.	Per cent.	Rs.
Imperial ...	17,540	...	67,920	...	...
Bengal ...	9,72,310	4,88,990	...	49·9	35·4
North-Western Provinces and Oudh,	15,68,040	5,96,090	...	38·0	146·1
Punjab ...	14,74,430	6,19,090	...	41·9	82·7
Burma (Lower) ...	42,22,960	26,93,390	...	63·7	350·7
Burma (Upper) ...	41,27,930	32,31,310	...	75·4	404·5
Central Provinces ...	9,95,100	1,23,770	...	12·4	6·5
Assam ...	8,98,180	92,820	...	23·4	4·6
Cooch ...	1,55,070	74,970	...	48·3	83·7
Ajmere-Merwara ...	14,420	...	1,880	...	...
Ealuchistan ...	14,920	...	12,840	...	...
Andamans... ..	2,29,460	91,060	...	39·7	46·6
Forest School ...	2,360	...	61,010	...	...
Forest Surveys (Imperial).	290	...	33,680	...	...
Total ...	1,41,93,010	78,31,160	...	55·2	93·8
Berar ...	4,39,840	2,01,770	...	45·8	48·3
Total Bengal Presidency	1,46,32,850	80,32,930	...	54·9	91·5
" Madras "	21,10,520	5,15,850	...	24·4	26·3
" Bombay "	22,95,150	4,55,900	...	19·8	30·5
GRAND TOTAL ...	1,90,38,520	90,04,680	...	47·3	73·6

"The estimated value of forest produce for which no credit has been taken, and which was given away free or at reduced rates to right-holders and under free-grants, amounted to Rs.31,63,044."

Forest Administration in Native States.—"Copies of their annual administration reports have been received from Mysore, His Highness the Nizam's dominions, and Jodhpur.

"The report for Mysore was submitted by Mr. J. L. Pigot, who succeeded Colonel Campbell Walker, on the retirement of the latter officer from the 3rd January, 1899. There was a net addition of 202 square miles to the area of State forests, which stood at 1,747 square miles at the close of the year. The area of reserved lands was 266 square miles, of which 35 square miles

were nearly ready for constitution as State forests. Progress in forest settlement work is said to be hampered by the want of a law under which the State may secure legal right to reserved forests, and in virtue of which adverse rights or privileges of user may be properly provided for and recorded, and also by the want of special Settlement Officers. Demarcation in Mysore appears to have been hitherto carried out by antiquated methods, and to have been saddled with the cost of establishment which should be charged to other heads; it is therefore satisfactory to learn that steps to remedy these defects are contemplated. Rupees 3,447 were spent on surveys; but it is not clear what area was surveyed. The drawing up of several working-plans was in progress, but there is urgent need in most districts for short, simple plans of work. The percentage of convictions obtained in prosecutions for breaches of the forest rules, rose from 73 in the previous year to 81 per cent., but the punishments awarded were in some instances of so light a nature that they could not have had any materially deterrent effect, and the Government has since insisted upon the necessity of awarding adequate punishment in cases involving damage to sandalwood. According to the figures given in the Report, 1,368 square miles were protected from fire out of 1,435 square miles attempted, or 95 per cent., but the returns do not appear to have been reliable. The Conservator advocates concentration of fire-protection in smaller areas, and it is evident from his remarks that much has to be done to render fire conservancy in Mysore real and effective. Although plague interfered with some branches of forest operations, it did not affect the sales of sandalwood, and the financial results were rather better than those of the previous year. The revenue was Rs.11,82,146, the expenditure Rs.4,81,588 and the surplus Rs.7,00,558, as compared with Rs.6,66,348 in 1897-98. The total quantity of sandalwood sold was 2,074 tons, which fetched an average rate of Rs.381 per ton, as against 1,572 tons and Rs.386 in the previous year.

"The report of forest administration in the dominions of His Highness the Nizam of Hyderabad is for the year ending 6th October, 1898. At the close of the year the area of reserved forests was 4,035 square miles, of which 160 square miles were added during the year. Many of the most valuable forests are still in the open tracts, in which only certain species of the more valuable trees are under the control of the Forest Department; but the protection afforded to these open forests is said to be quite inadequate, and it is therefore satisfactory to learn that proposals to reserve an additional area of some 5,000 square miles are under consideration. Seventy-nine miles of boundaries were demarcated during the year, but much remains to be done in this direction, and the work is hindered by many boundary disputes. Owing to the reserved forests being surrounded by private estates, from which timber is often sold at nominal rates, the difficulty of working

the Government forests is very great, and this difficulty is still further aggravated by the want of export roads. A liberal policy in providing funds for the construction of roads, without which it is impossible to properly work the forests, and also for providing suitable quarters for the Forest establishment, is highly desirable, and such outlay would undoubtedly prove as remunerative in Hyderabad as it has elsewhere in India. The Conservator, Mr. Biscoe, in his report, brings prominently to notice the manner in which the forests are deteriorating, owing to illicit felling, and the impossibility of proper supervision owing to the utterly inadequate strength of the Protective establishment. Certain powers to fine for offences committed in reserved forests have been granted to Forest officials, and the results are said to be satisfactory. There was a large increase in the number of cases shown as compounded, which rose to 4,340, but it would appear that the cases in which fines were inflicted are included in this number. The Conservator's contention that it is of little use sending cases to the Courts seems to be borne out by the fact, that convictions were obtained in only 7 out of 23 cases disposed of by the Courts. In the absence of any law or rules on the subject, the difficulty of protecting the forests from fire is very great and cannot be attempted on a large scale; but it is satisfactory to note that there is some improvement in preventing or extinguishing fires before they have done much harm. One hundred and fifty-one square miles were successfully protected from fire against 16 square miles in the previous year. There was a great improvement in the financial results compared with previous years; the revenue realised was Rs.2,96,551, the highest on record, and the expenditure Rs.1,26,817, thus leaving a surplus of Rs.1,69,734.

"In Jodhpur the total area under the management of the Forest Department was 343 square miles, of which 8 square miles were fuel and fodder reserves. The famine caused a great increase in the number of cases of breaches of the Forest rules; 538 cases were compounded, as compared with 263 in the previous year, but the average amount realised per person fell from Rs.1-4-3 to Rs.0-14-9. The results of cases prosecuted in the Courts were unsatisfactory, convictions being obtained in only 4 out of 27 cases decided. Fire-protection was rendered comparatively easy, as owing to the scarcity of fodder the forests were swept clean of grass and fallen leaves before the fire season began. Only 4 acres of forest were burnt out of 215,000 acres placed under protection. The financial results showed some improvement over those of the two previous years, but were still adversely affected by the continued drought. The revenue realised was Rs.28,643, and the expenditure Rs.20,925, leaving a surplus of Rs.7,718.

V.-SHIKAR AND TRAVEL.

Curious Behaviour of a Flight of Wagtails.

I SEND you an extract from a letter received by me the other day from a planter friend at Balur, Mysore, which I think will be of interest to some of your readers.

The wagtail, which is a migratory bird, as every body knows, comes down south with, or just before, snipe, and a flight of them must have been passing over Balur when the rain stopped them.

"A very funny thing occurred here the other night. I was reading in the sitting-room at about 9 P.M., and it was raining heavily outside, when a water wagtail flew into the room, and after a little while I found there were four of them. I did not take much notice of them until one flew on to the lamp and put it out, and then I thought it was high time to go to bed. So I went into my bed-room, and to my surprise found it was full of these birds. They had come in evidently to take shelter from the rain. They seemed quite tame, and several of them sat on my shoulder and on my hands. However, I did not want them flying about my room all night, so I caught them one by one and set them free in the drawing-room. In the morning two were found dead, evidently killed by the dogs, but the rest had all gone!"

OOTACAMUND: }
12th October, 1901. }

C. V. RYAN.

VI.—EXTRACTS, NOTES AND QUERIES.

The Birch (*Betula Bhojpattra*) Forests of Kashmir and their Treatment.

SILVER birch grows more or less scattered on all the higher ranges of hills, but the only part of the country where it exists in large quantities, and from where fortunately it can be extracted, is what is known as the Gurais district. This area lies on the northern side of the Kashmir Valley watershed, in the Kishenganga valley, and the main road from Srinagar to Gilgit passes through the village of "Gurais" itself.

Practically only those hills, on the left bank of the Kishenganga river and having a northern aspect, bear forests. These hills are well covered with a more or less pure silver fir (*Picea Morinda*) forest, the principal admixture being composed of blue pine (*Pinus excelsa*), spruce (*Abies Smithiana*), silver birch and other deciduous-broad leaf species. The birch grows pure above the silver fir at an elevation of about 12,000 feet above sea-level,

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and extends, intermixed with it and other species, right down to the Kishenganga river, whose level above the sea at this place is about 6,000 feet.

These forests are practically the only source from whence the useful "Bhojpatra" is exported to Srinagar. The bark is useful in manifold ways, but chiefly for the roofing of houses. The villagers still utilise it as writing-paper. A few of the other uses it is put to are for wrapping up parcels, sweets, &c., and for lining the baskets in which apples and other fruits are exported. Every villager keeps his snuff wrapped up in a piece to keep it dry, and it is used for binding up fesh graftings of fruit trees, &c.

The value of this commodity has gone up considerably in late years, and the price now obtained in Srinagar is roughly four rupees per maund, thus showing that the supply does not meet the demand. At present a lease is sold for collecting certain fees on birch bark exported into the Kashmir Valley and as Gurais has only recently come directly under the Forest departmental control, the method of removal from the trees has been anything but satisfactory. The old method employed was by villagers collecting the bark in their spare time and being paid for it by the lessee, delivered at Gurais or along the main road. So in reality the lessee, instead of only levying fees, owned the bark himself and disposed of it as it suited him best.

Up to date enormous damage has been done by nomadic Gujars, who lop and clean fell birch trees for fodder indiscriminately, and in many places have cut whole forests flush with the ground. Now, however, as a Forest establishment has been placed in Gurais district, this damage will, it is to be hoped, cease. Not only should this damage be taken into consideration as reproduction is also well nigh impossible where heavy grazing exists.

The method employed in the actual stripping off of the bark is as follows:—

A deep cut (usually extending into the sap wood) is made vertically down a clean piece of bole with a sharp knife-like instrument and the bark is then peeled off altogether by the hand, being levered up with the cutting instrument. The operation is very much the same as that employed when girdling pine trees, except that the upper and lower horizontal cuts round the bole are not made. The collector goes from tree to tree until enough has been gathered to make a load. He then binds it together with twigs and carries it to Gurais, or the nearest village on the main road, where it is bought by the lessee according to weight.

It stands to reason that injudicious barking damages, and in many cases kills, trees. The paper bark is doubtless a provision of nature to protect the trees from cold and damp. This covering is thrown off by an under-red bark full of sap, and apparently one

layer is produced per annum. Under the present method of stripping off the paper bark that is underneath exposed to the air. If only a short length is so treated, it dries up, becomes black and falls of its own accord, or is pushed off in flakes by a succeeding layer of red bark, which again performs the operation of giving off paper bark. If, however, long lengths are removed in several places, the tree dies from being practically girdled. It is obvious that even by stripping off the paper bark in short lengths and exposing the moist under-bark, the continuity of growth is broken, as a fresh lower bark must grow before a new supply of outer-bark can be obtained. This method is therefore objectionable for the supply of birch bark, as the period of time between a first and second collection from the same tree is greatly increased.

Lopping of branches is naturally deleterious to the quality and supply of saleable bark as knots and excrescences are formed, and so clean strips of a good length cannot be obtained.

The size of tree most suited for the supply runs from 8 inches to 18 inches in diameter. In larger trees the paper bark or the bole becomes coarse and lignified, and so is useless as an article of commerce, although a certain amount may be obtained from the main branches.

From the above the following rules would appear to be necessary to work birch forests successfully :—

- (1) No lopping to be allowed.
- (2) Grazing must at least be regulated to ensure reproduction.
- (3) That the vertical cut made when collecting the bark must not pierce the under-bark.
- (4) That at least two bands of paper bark must be left on the bole when collecting.

If these rules are carried out, the supply of bark should be doubled or trebled.

I should be extremely thankful for any advice on the working of birch forests from anybody who can give it.

KASHMIR :
November 11th, 1901. }

E. RADCLIFFE,
Divisional Forest Officer.

The Forests of New South Wales. *

J. H. MAIDEN,


Government Botanist and Director of the Botanic Gardens, Sydney.

INTRODUCTORY.

MY subject to-night is "The Forests of New South Wales," not "The Forestry question in New South Wales," a very different matter.

I propose to deal with facts, not opinions, and will endeavour to give some idea of the resources of New South Wales from the

* Extract from a lecture delivered by invitation before the Royal Society of New South Wales, 22nd May, 1901.



point of view of the forester. I claim an intimate knowledge of our trees, for I have for many years been engaged in their botanical investigation. The diagnosis of timbers has always had a peculiar fascination for me. I have travelled much in our forests, and am now engaged in systematically travelling through them. I believe that the more these forests are known, the more they will be valued, and critical knowledge of them will be the best antidote to the hysterical over-valuation of them on the part of those who take but a passing interest in them, and to the pessimist, who professes to believe that they are practically cut out and unworthy of the serious attention of our legislators. At the same time I should be lacking in my duty if I did not earnestly point out that some of our commercial timbers are getting scarcer and scarcer in comparatively accessible localities; we have overwhelming testimony of this. Much of our material prosperity depends on the state of our timber industry, and I would also lay emphasis on the fact that a flourishing state of the timber market means the employment of large numbers of men in healthy occupations in our forests, which are distributed over a large area, and their withdrawal from the congested populations of Sydney and Newcastle.

BRUSH AND OPEN FOREST.

The timbers of New South Wales are found, for the most part, in either brushes or open forests. The brush corresponds to what in India is called jungle, and consists of well-watered rich-soil areas, chiefly in the coast belt and coast tablelands, which not only support rich arboreal vegetation, but also creepers and climbers of various kinds, and shrubby undergrowth. The tree vegetation is of the most varied character, but rarely includes Eucalypts. In open forests, on the other hand, Eucalypts form the prevailing vegetation, and, in the coast districts, frequently attain a great size. As compared with brush forests, the soil is less rich and moist. Of the open forest timbers we possess a fair knowledge; it is mainly in regard to brush timbers that our knowledge is defective. This results from a variety of causes. In brushes the variety of trees is very great, and they are less gregarious (as regards individuals of the same species) than those of the open forest. There is a great deal of uniformity in the barks of brush trees, a nearly smooth bark being of common occurrence, while the trees are so close together, that their leafy tops intertwine, and it is impossible, in many cases, to get a fair idea of the shape and general appearance of a particular tree. Only those who have visited our dense northern brush forests can form an idea of the difficulty of distinguishing more than a few kinds of trees. Their massive trunks, wonderfully vertical, remind one of cathedral columns; craning the neck for an upward view in the dim forest is inconvenient and even painful, and results in only general impressions, while if a gun be fired with the view of bringing down a twig for purposes of identification, the probability is that

it cannot be stated, with certainty, from what particular tree the specimen has fallen. If one cuts through a tree, it very often happens that other trees prevent its falling down, and thus its leafy top is not available for examination.

OUR PRINCIPAL TIMBERS.

Ironbark.—We have four ironbarks :—

- (1) The white or grey ironbark ;
- (2) The narrow-leaved ironbark ;
- (3) The broad-leaved ironbark ; and
- (3) The red ironbark, or mugga.

(No. 1) *Eucalyptus paniculata*, Sm., is confined to the coast districts, and is paler than the others, although it varies in colour to a pinkish and even pale red colour, so that in the south it is sometimes known as "red ironbark"; this is the hardest, toughest, and most esteemed of our ironbarks.

(No. 2) *Eucalyptus crebra*, F. v. M., is very widely diffused. It is the principal ironbark in that enormous stretch of country between Dubbo and Pilliga, &c., and also forms a part of the ironbark country east of Dubbo. But in greater or less abundance is it found over the whole of the north-eastern fourth of the State. It is red in colour, is known in the trade as "red ironbark," and is a valuable timber. It is a narrow-leaved, drooping species, the most graceful of the group.

(No. 3) *Eucalyptus siderophloia*, Benth.—This is largely developed in the Clarence River Ironbark district, but it extends along the coast and for a considerable distance south of Port Jackson. Like the preceding one, it also is well developed in the interior, though not to so great an extent. It crosses the dividing range, and is abundant north of Dubbo, and is more or less diffused in the *crebra* country between the interior and the coast, but it is much less plentiful in most districts than *crebra*. It is always known as red ironbark, and is a valuable timber, though occasionally it is too free to be classed as best ironbark.

(No. 4) *Eucalyptus sideroxylon*, A. Cunn.—This is *par excellence* the ironbark of the interior; at the same time there are few districts of the State, even in the coastal belt, in which it is not found sparingly. It penetrates furthest into the interior of the ironbarks, being found at least as far west as Nymagee and Mount Hope, is well diffused in the south-western portion of the State, where it is the only ironbark tree, and is the only ironbark that extends into Victoria. In the northern half of the State it is also found, but, as a rule, not forming dense forests. It is a less compact tree than the others, yields timber of a deep-red colour and, although the least valuable of our ironbarks, is a valuable timber, often the best in the districts in which it grows.

Box.—The term "box" is applied in Australia to trees with tough interlocked timber, and with a tough fibrous bark not so fibrous as stringy bark. When properly applied and unaccompanied by depreciatory prefixes as "bastard," "swamp," &c., it refers to durable timbers, including some of the very best in the State. They are as follows:—

- (1) White or grey box (*Eucalyptus hemiphloia*, F. v. M.)
- (2) Fuzzy box (*Eucalyptus conica*, D. & M.)
- (3) Narrow-leaved box (*Eucalyptus Behriana*, F. v. M.)
- (4) Black or flooded box (*Eucalyptus largeflorens*, F. v. M.)
- (5) Red box or slaty gum (*Eucalyptus polyanthema*, Schau.).
- (6) Yellow box (*Eucalyptus melliodora*, A. Cunn.).
- (7) South Coast red box, the Bairnsdale box of Victoria (*Eucalyptus Bosistoana*, F. v. M.).

Such are the tentative names of our principal boxes. Those given to Nos. 1, 5, 6, and 7 are pretty uniformly in use, but the term "box" alone is usually given to Nos. 2, 3 and 4, and perhaps later on I may suggest better names than those I have indicated, though I am afraid it is of very little use, since people in different districts tenaciously hold to their own vernacular names, whether based on misapprehension or not, the scientific ones being alone, as a rule, of precise application. Boxes are found practically all over the State, in nearly all the districts in which timber trees are found. The zone marked "Cypress pine and box" contains abundance of all the boxes except No. 7, but the localities overlap each other, several species sometimes occurring in the same district.

(No. 1) *E. hemiphloia*, F. v. M.—This attains its greatest development in the coastal districts, but in its glaucous or white, large-fruited form (variety *albena*), it spreads over the greater part of the State. It is a pale timber, and is our commonest and best known box.

(No. 2) *E. conica*, Deane and Maiden.—This is a tree whose existence as a distinct species has only been recently recognised. It is largely developed in the cypress pine and box zone, usually occurring in low-lying country. A form, with usually (but not always) broader leaves, is found in the coast districts and in Victoria, and is known as '*Lignum vitæ*,' and by various other names, but there is absolutely no constant difference between this and the western form, and the localities are now connected. The timber is pale brown, and the bark is rather woolly or fuzzy.

(No. 3) *E. Behriana*, F. v. M.—Originally described from Western Victoria and South Australia as a large-leaved shrub; it will surprise a good many people to find that in this State (in which the tree attains its greatest development) it is commonly a fairly large tree, and with rather narrow leaves. It is sometimes known as "narrow-leaved box," in comparison

with *E. hemiphloia*, but I cannot find any name, other than box, in consistent use for it over a large area. It is abundantly developed in the cypress pine and box zone, and recently I have traced it eastwards as far as the Barrington Tops in the Gloucester district, where it is known as "Mountain box." It has a pale timber, and may be substituted for ordinary grey box with satisfaction to the user.

(No. 4) *E. largeflorens*, F. v. M.—Perhaps this might be referred to as "black or flooded box" for the present. It is one of several trees known as "Coolabah." It also bears the further aboriginal name of "Goborro," and has various other designations. It, however, will be readily recognized as a drooping box found on many of the river flats and swampy country west of the dividing range; it also has a red timber which sharply distinguishes it from all the other boxes referred to, except the red box. It is a durable timber, but it is often piped, and is only used in the immediate localities in which it grows.

(No. 5) *E. polyanthema*, F. v. M.—This tree is largely developed in the Wellington, Mudgee, and Gulgong districts, in the ironbark country, which really is box country also; it extends, though less abundantly, west and south from this. Thus it goes south into the cypress pine and box country to Grenfell, &c., and thence south-east into the southern mountain ranges. Its wood is of a deep-red colour, hence the name "red box," and it is one of the most durable timbers we have. At first sight it would not be taken for a box, having not the fibrous bark of the other boxes, but more closely resembling the forest red gum (*Eucalyptus tereticornis*, Sm.) in general appearance. It has usually more or less scaly bark about the butt, and this scaly bark often extends higher up the timber, and is sometimes more or less ribbony. Sometimes the bark (at certain seasons) is nearly smooth and glaucous, giving the tree a white or slaty appearance, and hence the name "slaty gum." But there is no difference between a red box and a slaty gum. The species exhibits very little variation, and in some districts the terms slaty gum and red box are indifferently used, by the same persons, to the same individual tree.

(No. 6) *E. melliodora*, A. Cunn.—This is a well-known tree occurring in the mountain ranges and tablelands north and south, and extensively distributed in the drier parts of the State. As a rule, it does not form large forests, but it extends, more or less sparsely, over vast areas. It is a beautiful tree, often with pendulous foliage, and in the bush is at once recognised by an axe-cut which reveals the inner bark as yellow as the proverbial guinea, hence the name "yellow box" or "yellow jacket." It is not one of the largest of our trees, but is commonly used and much esteemed for strength and durability. It belongs to the pale-coloured section of the boxes.

(No. 7) *E. Bosistoana*, F.v.M.—This occurs on the south coast and into Gippsland. Northerly it is found at least as far as the vicinity of Sydney. It has much the appearance of the grey box (*E. hemiphloia*) and grows in much the same situations, but it is somewhat redder in the timber, and hence, by way of distinction, it is locally known as "red box." But it must not be confused with the intensely red "red box" known botanically as *E. polyanthema*. It is a strong and valuable timber and forms an efficient substitute for grey box.

Stringy barks.—Included in this name are a number of trees which possess the common characters of (a) very fibrous bark, bark which clothes the entire stem with a thick fibrous coating of fibres longitudinally arranged, so that the bark can be removed in long pieces; (b) fissility of timber. They are included in the following species:—

- (1) *Eucalyptus eugenoides*, Sieb.
- (2) *Eucalyptus capitellata*, Sm.
- (3) *Eucalyptus macrorrhyncha*, F. v. M.
- (4) *Eucalyptus Muelleriana*, Howitt, "yellow stringy bark."

As regards the first three stringybarks, the colour of the timber varies a good deal. *E. eugenoides* is called "white stringybark" in some districts and red in another, and the other two have changing vernacular names, are usually known simply as "stringybark." They are found in the coast districts and coast ranges and tablelands. *E. macrorrhyncha* extends further into the western and south-western interior than do the other species. The "yellow stringybark" is closely allied to "blackbutt," and occurs in the coastal districts and dividing range and spurs from the south to north of the State. The stringybarks are useful timbers, the yellow stringybark being the most valuable, but, taken as a whole, are inferior to the groups of ironbarks and boxes. Most of the ironbarks are, as we have seen, red in colour, and most of the boxes are pale. The stringybarks vary in colour, but are mostly pale. The three groups comprise a large number of our timbers.

To include the remainder of our *Eucalyptus* hardwoods of first importance, we may group them into pale hardwoods and red hardwoods. Australian pale hardwoods are looked askance at in some markets, because there has been substituted for some of them some valueless timbers of a pale colour; nevertheless the group includes some of our most valuable woods.

Pale Hardwoods.—I may enumerate here —

- (a) Black butt (*Eucalyptus pilularis*, Sm.).
- (b) White mahogany (*Eucalyptus acmenoides*, Schau.).
- (c) Tallowwood (*Eucalyptus microcorys*, F. v. M.).
- (d) Spotted gum (*Eucalyptus maculata*, Hook. f.)—all coastal timbers.

Blackbutt is so-called because of the dark bark on the butt, and is found in both the south and north districts. It is one of

the most generally useful of our timbers, and is valued for its durability. Blackbutt is in some respects intermediate in character between box and stringybark. It most readily re-afforests naturally of all our hardwoods, which is an important factor in tending to secure the permanence of our blackbutt forests. Blackbutt prefers good soil.

White mahogany may be found on most sterile country—on dry hillsides and on mountain ranges. The timber is useful, though the least valuable of the group of four now under discussion. The trees and the timber resemble stringybark a good deal. White mahogany is only found north of Port Jackson.

Tallowwood, so-called because of its greasy nature, is only found in our rich north coast forests, and is one of the handsomest of our native trees, many of the specimens being fit subjects for the artist's pencil. It also forms one of the largest trees of New South Wales, though these giants of the forest, which have been growing through the ages, are only of practical forestry interest to the timber-getter, who first converts them into timber, for they cannot be replaced except after the lapse of ages. A good many people look upon tallowwood as the most valuable of our hardwoods; to discuss whether it is better than ironbark, is to discuss such a proposition as to whether apples are better than pears.

Spotted gum is a very valuable timber. It occurs in the north and south coast forests, usually on poor soil, and is readily known by its smooth blotched bark. The sapwood of this tree, which is often thick, is the most perishable of those of any of our hardwoods, and has helped to give the timber a bad name with some people; but free of sap and heart (as timbers should be), spotted gum possesses many merits. It is very durable, one of the most durable of our timbers, while its toughness makes it a special favourite of the wheelwright and carriage-builder.

Red Hardwoods.—Timbers of this colour are usually very durable, hence people who have been victimised by receiving bad pale hardwoods frequently specify only red hardwoods. But even amongst red hardwoods we may have inferior timbers, some of the white gums, for example, having red wood. Our red hardwoods include—

- (1) Red mahogany (*E. resinifera*, Sm.).
- (2) Grey gum, which includes two species (*E. punctata*, DC., and *E. propinqua*, Deane and Maiden).
- (3) Murray red gum (*E. rostrata*, Schlecht).
- (4) Forest red gum (*E. tereticornis*, Sm.).
- (5) Sydney blue gum (*E. saligna*, Sm.).
- (6) Woollybutt (*E. longifolia*, Link and Otto).

The whole of these belong to the coastal belt, with the exception of the Murray red gum, whose principal habitat has already been indicated; it also is found near watercourses in the greater part of the western half of the State.

Red mahogany is chiefly found in the north Coast districts, though it is sparingly found for many miles south of Sydney. It is of a rich-red colour, and is one of the most durable of our timbers. It has a fibrous bark, and is a handsome tree.

Grey gums have bark of a dull grey colour, and somewhat blotched. The bark is a little roughish, in contradistinction to the smooth and even shiny appearance of that of some of our gums. Grey gum is one of the most valuable timbers of New South Wales, and is one of the principal timbers to be relied upon as an ironbark substitute, and thus to arrest the depletion of our ironbark forests. The best description of it as a timber lies in the fact that it is difficult to tell it from red ironbark on appearance only; an expert usually discriminates between the two by noting the tensile strength of a fibre. It is a remarkably durable timber, and the only cases in which it should not be substituted for ironbark are where the tensile strength of best ironbark is required. It is largely used and esteemed in New South Wales, and can be recommended with the utmost safety to the foreign buyer.

Murray red gum is well and favourably known, partly because it is the most gregarious of New South Wales trees. As with the Western Australian jarrah, so with Murray red gum, there is no difficulty in supplying a practically unlimited demand of a timber of one uniform quality. We have other trees yielding timber of quality equal and even superior to these two, but because they are more scattered in distribution, there is always some liability to admixture with other timbers.

The forest red gum is botanically closely related to the Murray red gum; in fact, in their extreme forms the species run into each other; but, as a general rule, while the Murray red gum frequents river banks and flats, the forest red gum generally (but by no means always) prefers dry, open forests. Its durability is superior to that of Murray red gum, many experts always selecting it in preference to the latter when both are available. This preference of forest red gum is another instance of the general truth of the observation that the best timbers grow in dry or, at least, well-drained localities.

The Sydney blue gum may be so called to distinguish it from the pale-coloured blue gum (*E. globulus*, Labill.) of Tasmania and Victoria. It, however, occurs in both north and south Coast forests, preferably on rich damp land or flats. In this respect it is similar to Murray red gum. It forms magnificent straight trunks, is extensively used, being one of the best of our timbers where durability is required. It is much sought after for felloes of wheels.

Woollybutt, found in the south Coast forests, is the least known of the group. Yet, although not of the first-class on account of deficient tensile strength, it is undoubtedly a durable and generally useful timber. A good many people use it without

knowing what it is, but it can stand on its merits, I think. Its bark is sub-fibrous, and its timber is not unlike red ironbark.

I have omitted a few of our Eucalyptus hardwoods that I might have included, but time does not permit of the inclusion of a complete list.

Turpentine and Brush Box.—Turpentine and brush box are useful hardwoods, and both occur in the coastal forests, the former from the Shoalhaven to the Tweed, and the latter in the northern forests from Port Stephens northwards, usually in brushes, but often in open forests. Turpentine is botanically known as *Syncarpia laurifolia*, Ten.; and brush box is *Tristania conferta*, R. Br. Though not Eucalypts, they are closely related thereto. Turpentine is so called because of the peculiar oleo-resin it exudes; it forms magnificent straight trees in deep gullies, and is, perhaps, the most generally useful of our timbers resistant to marine borers, hence its very extensive use for piles in harbour works. It also has the great merit of being almost unflammable, and hence is sometimes used for beams in buildings. Brush box is a durable timber, obnoxious to white-ants; it has other merits, and in spite of its tendency to warp, it should be more largely employed than it is at present. It is one of the most beautiful of our trees, and is often seen in gardens and boulevards under the name of "Lophostemon."

Cedar, Beech and Hoop Pine.—These valuable timbers I must dismiss in a few words. They are chiefly found in the area marked blue on the map, as already indicated, though cedar is found in patches in mountain fastnesses in a latitude as far south as Sydney. Red cedar (*Cedrela australis*, F. v. M.) is one of our few deciduous trees, and is a denizen of rich brush forests. The timber takes the same place here that the West Indian mahogany does in Europe; our cedar being, however, much lighter in weight. Closely allied to it and substituted for it to some extent, are Rosewood (*Dysoxylum Fraserianum*, Benth.) and red bean (*D. Muelleri*, Benth.), valuable timbers, though less esteemed than red cedar. White beech (*Gmelina Leichhardtii* F. v. M.) is another instance of a handsome tree yielding a valuable timber. It is of a pale colour, durable, does not shrink much, and is one of the best carving timbers we have. It is the most esteemed of a number of brush timbers of the same class, of which flindersia or cudgerie (*Flindersia australis*, R. Br.) is one of the most important. Hoop pine, or white pine, or Colonial pine, or Richmond pine, are all names for the timber of *Araucaria Cunninghamii*, Ait., which occurs in brush lands at the heads of our northern rivers. Araucarias form remarkable looking trees in the forest with their branches in whorls and their conical habit. They are more often planted for ornamental purposes than for timber. The hoop pine is our most abundant soft wood of the pine class, and is a useful timber, particularly in a country whose predominant vegetation is hardwood, yet it falls far short of the best soft woods of the Baltic and the Pacific Slope.

Cypress pine covers extensive tracts in the drier pastoral districts, and is chiefly confined to the western and southern plains and tablelands. It is usually more or less admixed with box of various kinds, although there are large areas entirely covered with pine. The cypress pine area has been already indicated on the map, and the pines therein consist mainly of two species, Murray or white pine (*Callitris verrucosa*, R. Br.) and red or black pine (*Callitris calcarata*, R. Br.). Other species extend to the Coast ranges and tablelands (forming, for example, dense forests in New England gullies), and even to the Coast, the beautiful cypress pine of Port Jackson being a case in point. Cypress pines are beautiful trees, and yield valuable timber in the arid districts in which they grow. Such timber is usually highly ornamental, even garish, in figure and colouring. Its chief merit is its resistance to white-ants, which enables it to be used for telegraph and fence-posts, in country infested with those insects and carrying but little other timber. It is also commonly used for house construction, and stands well. It is full of aromatic resin, and hence burns readily, diffusing a sweet fragrance. The attention of the forester has, during recent years, been a good deal devoted to thinning areas of cypress pine, work which will afford the State an adequate return if it be carried out under experienced direction and on business principles. Residents of the Coast districts do not readily realise what the conservation of our cypress pine forests means to the arid western districts which do not possess the abundant and comparatively accessible forests of the Coast belt. Cypress pines are small or medium-sized trees, compact and shapely in habit, and quite different in appearance to the hoop pine. They grow readily (too readily many people think) from seed, and are well worthy the attention of those who desire to cultivate the most horticulturally desirable of our native plants.

Miscellaneous.—I have only time on this occasion to mention by name brown pine (*Podocarpus elata*, R. Br.) of our northern forests; the silky oaks (*Grevillea robusta*, A. Cunn., and *Orites excelsa*, R. Br.) of our northern rivers and tablelands; the black bean (*Castanospermum australe*, A. Cunn.), from the Clarence to the Tweed; the tulip wood (*Harpullia pendulata*, Planch.) of the northern brushes; the myall (*Acacia pendula*, A. Cunn., of our western plains); the she-oaks (*Casuarina*) distributed practically all over New South Wales.

STATISTICS.

Regulations and Administration.

Regulations were established in 1877 under the Crown Lands Act. These were amended and re-issued under the Crown Lands Act of 1884, by *Gazette* notice, dated 20th August, 1885, and again amended and re-issued under the same Act by *Gazette* notice of the 22nd March, 1895. A Forestry Act was projected under the administration of the late Director-General of Forests, Mr. J. Ednie

Brown, in 1891, but was not presented to Parliament. An amended Act was prepared in 1897, under the administration of Mr. Secretary Carruthers, but before it was presented to Parliament the Government vacated office.

The administration of Forestry was transferred in 1878 from the Department of Lands to the Department of Mines; retransferred in 1888 to Department of Lands; transferred in 1889 to the Colonial Secretary; retransferred in 1892 to the Department of Mines; and again retransferred, in 1897, to the Department of Lands.

Following is a record of the Forestry Field Staff since the formation of a Forestry Department or Branch :—

1875	...	...	3 officers.	1890	...	...	36 officers.
1879	...	...	18 "	1891	...	...	36 "
1880	...	...	18 "	1892	...	...	36 "
1881	...	...	17 "	1893	...	...	35 "
1882	...	...	17 "	1894	...	...	35 "
1883	...	...	39 "	1895	...	...	28 "
1884	...	...	39 "	1896	...	...	0 "
1885	...	...	39 "	1897	...	...	10 "
1886	...	...	39 "	1898	...	...	15 "
1887	...	...	38 "	1899	...	...	18 "
1888	...	...	35 "	1900	...	...	19 "
1889	...	...	36 "				

* Exclusive of 39 Conditional Purchases Inspectors, who also are nominally Foresters.

Revenue and Expenditure of Forest Department.

Year.	Revenue.	Expenditure.	Year.	Revenue.	Expenditure.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
1877 ...	4,324 10 3	4,579 7 6	1889 ...	17,137 1 11	18,211 12 1
1878 ...	5,934 14 0	5,592 12 6	1890 ...	15,436 15 11	20,779 3 10
1879 ...	7,945 18 2	5,920 2 11	1891 ...	18,455 9 7	23,875 0 3
1880 ...	8,990 4 3	6,635 10 0	1892 ...	16,176 8 11	21,634 15 9
1881 ...	10,812 13 8	7,993 4 11	1893 ...	9,546 14 10	19,459 8 8
1882 ...	13,046 18 10	12,591 19 5	1894 ...	6,333 1 1	15,533 7 3
1883 ...	16,65 19 7	15,389 15 11	1895 ...	7,094 14 10	13,866 19 1
1884 ...	18,250 5 8	17,480 14 5	1896 ...	8,725 17 9	8,356 0 8
1885 ...	13,863 2 8	18,145 17 6	1897 ...	8,760 5 4	3,620 17 9
1886 ...	14,606 12 3	17,932 15 4	1898 ...	10,952 9 1	3,136 8 10
1887 ...	12,219 18 9	18,038 0 2	1899 ...	11,866 8 9	5,222 18 6
1888 ...	19,727 18 5	19,505 1 5	1900 ...	14,420 17 2	5,101 4 4

The revenue is made up of royalties, fixed-license fees in forest reserves and licenses on Crown lands, rent of prickly-pear leases (placed under the Forest Department as a matter of administration), sales of seized timber, and penalties. As regards expenditure, since the second half of 1896, the staff has been greatly reduced; at the same time the figures for 1896 onward do not

include any portion of the salaries of the Inspectors of Conditional Purchases.

The forests of Australia have been estimated to extend over 205,135,000 acres, the geographical area being 1,969,311,760 acres. The forest area of New South Wales is estimated at 20,000,000 acres; geographical area, 198,638,080 acres. It will be understood that the estimates of the area of forest lands are little more than guess work. We have far too few data at present on which to make even an approximate estimate.

Areas reserved for Forestry Purposes in New South Wales,
1879 and subsequent years.

Year.	Area in acres.	Year.	Area in acres.
1879	2,991,466	1890	5,459,937
1880	3,184,655	1891	5,600,653
1881	3,759,796	1892	5,694,034
1882	Not available	1893 and 1894	Not available.
1883	4,893,826	1895	5,641,278
1884	5,390,513	1896	5,596,521
1885	5,675,950	1897	5,610,184
1886	5,460,125	1898	5,896,581
1887	5,656,231	1899	5,946,355
1888	5,636,240	1900	6,355,605
1889	5,553,388		

These reserves, which are controlled under the Land Act of 1884, not being effectively protected by law, can be revoked at any time at the pleasure of the Government. They are almost wholly occupied under pastoral or grazing leases, and for the purposes of forest working are divided into three classes. In one class, which it is considered includes a great deal of the best timber, the royalty system is in force, in addition to a license fee. In the other two classes, fixed-license fees, usually current for a term of three months, are charged to timber-getters.

Mills and Outputs.

	Mills.	Hands	Horse-power.	Value.	Superficial feet.
				£	Annual output.
North Coast	80	1,262	1,927	83,220	51,500,000
South Coast	28	203	465	11,175	5,000,000
Murray River	8	59	98	3,550	1,250,000
Estimate, other districts	20	150	400	10,000	5,000,000
Total Colony	136	1,674	2,890	107,945	65,750,000

Table showing approximate annual extent of Crown forest improvement works by way of thinning, re-thinning, cleaning up, &c., also expenditure, from 1894 to 1900.

Year.			Area, Red-gum Forest, in acres.	Area, Pine Forest, in acres.	Area, Coastal Forest, in acres.	Expenditure.		
						£	s.	d.
1894	...	...	...	3,000	...	600	0	0
1895	...	...	52,764	27,622	2,000	33,248	0	2
1896	...	...	18,580	40,246	...	25,260	3	4
1897	...	...	17,650	44,502	...	9,320	19	9½
1898	...	...	8,360	...	...	4,020	0	3½
1899	...	...	9,000	39,018	...	4,270	0	9½
1900	...	...	7,500	25,944	...	4,733	15	10½

Forest Thinning and Improvement.

The total area of each class of forest improved by the Crown from inauguration of the work in 1894 to the close of 1900, is as follows:—

			Acres.
Red-gum forest	...	...	81,653
Pine	„	...	130,100
Coastal	„	...	2,000

Export of timber, the produce of New South Wales, was valued at £53,780 in 1891, £102,218 in 1899, and £88,636 in 1900. It comprised principally ironbark to New Zealand, for railway sleepers and bridge construction, also ironbark, tallowwood and turpentine for harbour works. Value of export to New Zealand in 1900, £29,084.

To Great Britain, blackbutt, tallowwood, and mahogany for paving; ironbark for railway sleepers; blackbutt and tallowwood for railway carriage construction,—were exported of the value, during 1900, of £6,637.

To South Africa, ironbark, blue and grey gum, and turpentine for railway sleepers.

To Victoria, spotted-gum for ships' planking and coach-building; ironbark and spotted-gum for wheelwrights' work; tallowwood and blackbutt for street-paving.

Outlook for Forestry in the Philippines.

CAPTAIN GEORGE P. AHERN, Director of the Forestry Bureau at Manila, who has been in the United States for several months past studying forest conditions, will leave for the Philippines late in September, to again take up his duties there.

Captain Ahern, before leaving for the Philippines, gave the *Forester* the interview that follows.

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In speaking of the outlook for forestry in the Philippines, Captain Ahern said: "I consider the Philippines the most interesting field in the world for the practice of scientific forestry. There are more than 50,000,000 acres of public woodland in the Archipelago. Up to date 665 species of trees have been classified, and it is the opinion of botanists that a close examination will bring the total up to fully 1,000. In several large districts of the southern islands of the Archipelago, more than 50 varieties of rubber trees are found. The true gutta-percha (*Isonandra gutta*) is found there. Hardwoods make up the bulk of the timber found, a number of these being especially valuable for ship-building.

"The forest service in the Philippines will grow, and more men will be needed from time to time. The Bureau of Forestry of the United States Department of Agriculture has been made an agent for the Forestry Bureau of the Philippines in securing men for the service there. Only men who have had some training in forestry will be considered, and all applicants will be required to take the Civil Service Examination. Arrangements are being made with the Forest schools of the United States looking to the establishment of courses in the study of Gutta-percha and Rubber. At present there is no official in the Philippines competent to take charge of the large rubber and gutta-percha districts.

"A Timber-testing laboratory is to be established at Manila, and will be in the charge of Mr. S. J. Neely, who conducted the timber-testing for the Division of Forestry a few years ago. The work at this laboratory will include the investigation of all native woods, methods of preservation, and economic uses. During the first year or two, the effects of the bureau will be concentrated on learning what we have in the way of forest products, the uses of the woods, and looking up markets.

"The forestry bureau of the Philippines, during its first fiscal year, produced in revenue over \$199,000 (Mexican), solely from forest products, and it may be stated that the receipts were quite poor during the early months, thus showing a remarkable gain as the year advanced. At present the revenues are almost \$30,000 (Mexican) per month.

"The Spanish administration in its best years never collected over \$12,500 per month (Mexican) from the sale of forest products, and there is this interesting difference to be noted: Spain charged more than 90 per cent. of the revenue receipts for service and materials. Under the present Bureau only 26 per cent. of the revenues go for service and materials. Spain on an average issued 1,000 licenses per year, while the United States has about 500 licenses operating.

"As to the question of markets, at present, every stick of timber cut is sold in Manila. People in other provinces are unable to get timber owing to the high prices paid by consumers in Manila; but in a year or two people in other provinces will begin to build, and when they are somewhat satisfied, the builders

in Hong-Kong and other Oriental ports may secure a few cargoes. Engineers in Hong-Kong were informed last December that it would be three years before they could receive any timber from the Philippines.

"The United States will receive only a few of the high-grade cabinet woods, which can be delivered in San Francisco, at a figure to compete favourably with the hardwoods of Central and South America. In, say from five to ten years, the Philippines will be able to supply the entire demand of the Archipelago, and a great deal of Oriental trade, especially at Hong-Kong and other Chinese ports. China will certainly be the best market.

"A great deal of building is going on in Manila, and better houses are being erected since the arrival of the Americans. Many towns were burned during the war, and the people have been unable to build them owing to the lack of material.

"Present methods of lumbering are entirely too primitive. The Spaniards and Filipinos do the bulk of the cutting, very few Americans being engaged. The natives are poor lumbermen, and in comparison with the Americans as workmen are greatly outclassed, one American being as useful as half-a-dozen Filipinos.

"In lumbering operations in the Philippines, the question of transportation is the most serious one. Wagon-roads are poor; there is but one railroad, and the rivers are not in good condition for log-driving; though there are many streams that with a little cleaning out will do very well for log-driving. At present the only mode of transportation is the water buffalo or caribao, an animal much weaker than the ox, used in American lumbering. There are also the Filipino ponies which are small and lack strength, but there are no American horses in the Philippines, except those belonging to the army. There has been some talk of importing elephants from India, but as attendants would have to be brought, and conditions are so different, the feasibility of the plan is doubted.

"To show the extent of lumbering operations under present methods, it is only necessary to state that the cut of the past year has been only 30,000,000 feet board measure.

"Mr. Ribbentrop, lately retired Inspector-General of the Forests of India, has written to us, in reply to an invitation from our Bureau, offering his services for the purpose of devising a rational forest policy for the Philippines. We are much pleased at Mr. Ribbentrop's offer, and it is hoped that arrangements can be made to secure his services, as the forest problems of the Philippines are much the same as those the Indian foresters have had to contend with. We also hope to secure for a limited period the services of a few of the Conservators of the Indian forests to help out in the inaugural work of the Philippines. These men would be especially valuable owing to their practical experience under very similar conditions that are to be met with in the Philippines."

THE FORESTER.

VII.—TIMBER AND PRODUCE TRADE.

Churchill and Sim's Circular.*4th November, 1901.*

EAST INDIAN TEAK.—Prices in London are again a shade firmer than last month in consequence of a continuance of the good consumption here. For the month the figures are 1,416 loads delivered, against only 173 loads in October last year, and for the ten months this year they are 11,996 loads against 9,000 loads to the same date in 1900. The lack of immediate demand for floating cargoes continues to characterise the outlook for further supplies and is not very easy to understand.

ROSEWOOD, EAST INDIA.—Although only very low prices could be realised, most of the stock has been sold, but shipments cannot be recommended as consumers and dealers are well supplied.

SATINWOOD, EAST INDIA.—Plain or faulty wood is only saleable at very low prices, but figury logs bring good rates, stocks are, however, too heavy.

EBONY, EAST INDIA.—Is in fair demand, with no stock on hand.

PRICE CURRENT.

Teak, per load	...	...	£10 to £17-5s.
Rosewood, per ton	...	...	£5 to £9.
Satinwood, per superficial foot	...	...	5d. to 12d.
Ebony, per ton	...	...	£9 to £12.

Denny, Mott and Dickson, Limited.**WOOD MARKET REPORT.***London, 4th November, 1901.*

TEAK.—The landings in the London Docks during October consisted of 558 loads of logs and 476 loads of planks and scantlings, or a total of 1,034 loads, as against 1,033 loads for the corresponding month of last year. The deliveries into consumption were 533 loads of logs and 895 loads of planks and scantlings, together 1,428 loads, as against 811 loads in October, 1900.

The Dock stocks at date analyse as follows:—

7,562 loads of logs, as against 8,947 loads at the same date last year.					
4,575	"	planks	"	5,060	"
99	"	blocks	"	—	"
<hr/>		<hr/>		<hr/>	
Total	12,236	loads	"	14,007	loads

The above figures sufficiently indicate the soundness of the position maintained by shippers, and, so long as the consumption

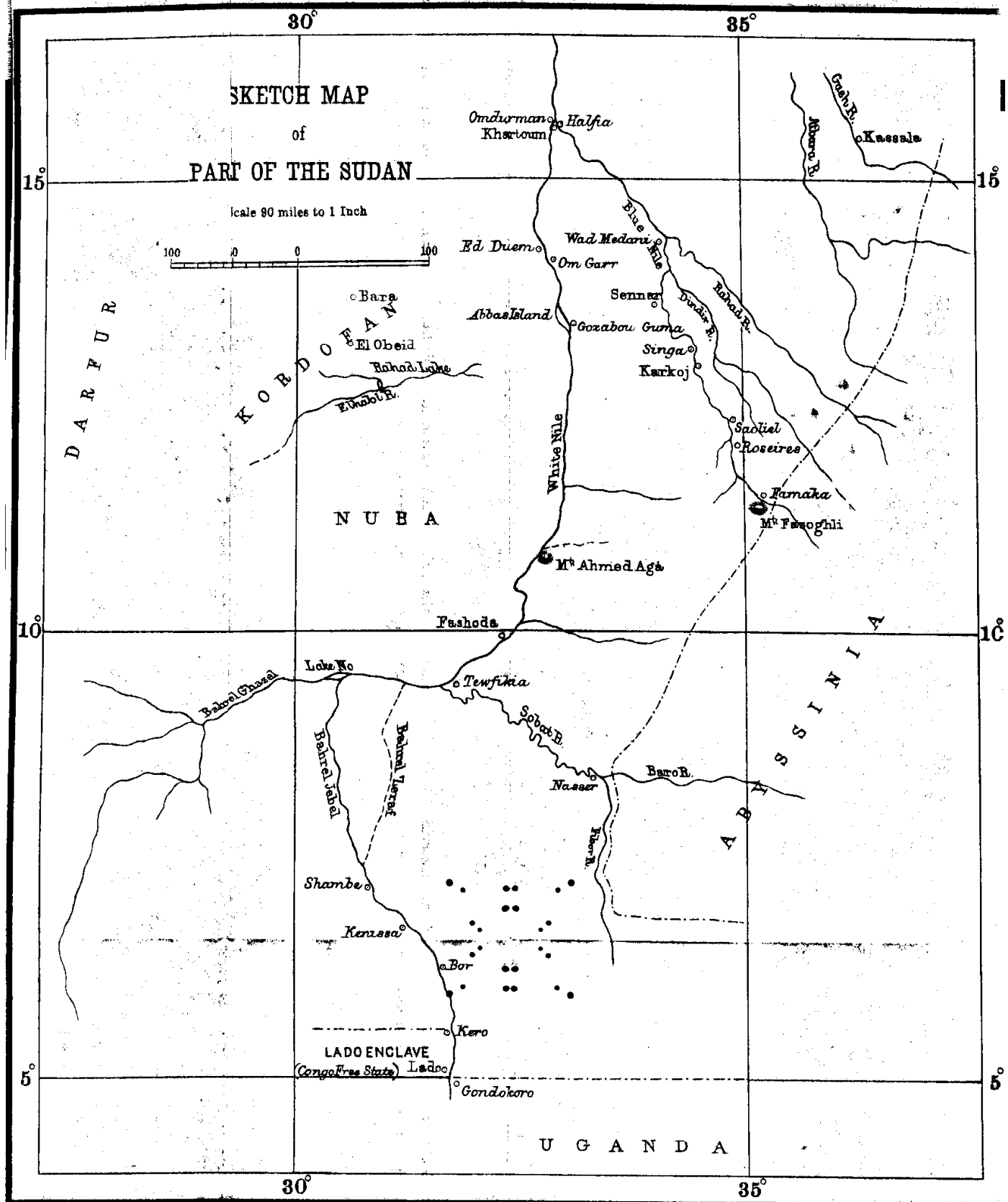
continues to exceed the imports, prices will be steadily maintained and perhaps appreciably stiffen, if only the present moderate rate of consumption holds good.

Business during October developed more confidence as to the near future of markets generally. Consumption was fairly satisfactory in volume, although eagerness to quit stocks gave no room for any all-round improvement in prices. Notwithstanding some anxiety as to the stability of petty buyers, timber trade finance continues sound enough to be little affected by the increase in the Bank rate, although such increase is not very welcome in times of little or no profit on current business.

Market Rates of Products.

Tropical Agriculturist, 1st November, 1901.

Cardamoms	...	... per lb.	3s. 3d. to 3s. 4d.
Croton seeds	...	... „ cwt.	17s. to 20s.
Cutch	...	.. „ „	28s. to 35s.
Gum Arabic	...	... „ „	20s. to 35s.
Do. Kino	...	... „ lb.	1s. 3d. to 1s. 6d.
India-rubber, Assam	...	... „ „	2s. to 2s. 6d.
Do. Burma	...	... „ „	2s. to 2s. 4d.
Myrobalans, Madras	...	... „ cwt.	5s. to 6s. 2d.
Do. Bombay	...	... „ „	4s. 3d. to 7s. 6d.
Do. Jubbulpore	...	... „ „	5s. to 6s. 2d.
Do. Calcutta	...	... „ „	3s. 6d. to 5s.
Nux Vomica	...	... „ „	7s. to 10s. 6d.
Oil, Lemon-grass	...	... „ lb.	5d. to 5½d.
Orchella weed	...	... „ cwt.	10s. to 12s. 6d.
Sandalwood, logs	...	... „ ton	£40 to £50.
Do. Chips	...	... „ „	£4 to £8.
Seedlac „ cwt.	62s. 6d. to 65s.
Tamarinds, Calcutta „ „	8s. to 10s.
Do. Madras „ „	5s. to 8s.



THE INDIAN FORESTER.

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[No. 2

Six Months in the Sudan.

It has been suggested to me that a short account of my tour through the Sudan forests might prove interesting to the readers of the *Indian Forester*, few of whom may see the more detailed account of the forests in its official form. The present article will also attempt to give some account of matters which would not find a suitable place in an official forest report, and of plantations in Egypt which were visited by the writer unofficially, after the report on the Sudan forests was written.

Cairo may be taken as the starting point of the journey, as it was there that preparations had to be made, servants engaged, kit and stores purchased, and other preliminaries arranged.

The fine avenues of *Albizzia Lebbeck*, which are such a feature of Cairo and its environs, are suffering much from the attacks of a boring insect said to be *Hystrocera globosa*; the trees have been much lopped, and the insect has doubtless effected its entry by the dead wood resulting. Few of the trees seem to be free from the pest, and their destruction seems to be a matter of time only.

Leaving Cairo on the evening of the 17th October, 1900, with all modern luxury of sleeping cars and dining saloon, which had, however, to be exchanged at Luxor the next afternoon for a noisy, dusty train of narrow-gauge carriages, we reached Shellal, where the rail ends just above the first cataract, at 9 p.m. on the 18th: here we found the Government sternwheel steamer "Tosci" ready to carry us to Wady Halfa. We were travelling with the mails, so the "Tosci" started without delay and ran day and night; the Nile was high, and there was little risk of stranding.

The river scenery between Shellal and Wady Halfa consists mainly in a narrow belt of cultivation and groves of date-palm, behind which rise in terraces hills of stratified rock (usually flat-topped and always destitute of vegetation), which form the commencement of the desert on either bank.

At Shellal is the beautiful island on which stands the temple of Phylla, and below lies the rocky gorge and cataract across which the big dam is now being constructed.

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Occasional sycamores (*Ficus sycomorus*), called "games" by the Arabs, help to consolidate the alluvial portions of the river bank and give shade, date-palms are cultivated generally and a few Saut (*Acacia arabica*) and Tarfa (*Tamarix articulata*) are grown to provide wood for making the "sakhiehs" (water-wheels), which, worked by blindfold bullocks, raise the water to irrigate the crops of grain and vegetables covering every available foot of ground on which they can be grown. The bifurcating dom palm (*Hyphane thebaica*) is met with south of Korosco.

At Wady Halfa the *Albizzia Lebbeck* has been planted extensively as a shade tree, and in the garden round the Officers' Mess a number of trees, among which eucalyptus may be cited as doing well, have been introduced.

Here we were hospitably received on the evening of the 21st October, and lodged for the night in the old "Sirdarieh," where Lord Kitchener planned and worked out the details which resulted in the successful campaign against the Khalifa and the reconquest of the Sudan.

The following morning, at 10, we started on our railway journey across the desert. The ordinary 1st class carriage of the Sudan Military Railway is a covered truck, and fitted up with one's camp kit and bath, it is a comfortable travelling medium, as I experienced on my return journey. For the present, however, we were accommodated in extra style, as a "tourist carriage" was attached to the train for our use.

We did not touch the Nile again until we reached Abu Hamed, and in this almost rainless country no vegetation is to be met with away from water. South of Abu Hamed the railway runs parallel to and at no great distance from the Nile through Berber and Shendi to railhead at Halfa (a very hot, shadeless place, for which Tommy Atkins supplied an English substitute sounding not unlike the native name and more descriptive).

North of Berber there is some Marakh (*Leptadenia spartium*) bush, and the remains of scattered Seyal (*Acacia spirocarpa*) and Saut (*Acacia arabica*): these latter trees have been lopped for fuel, and camels having browsed the shoots many have died.

Near Shendi there still remain some wooded areas under Seyal and Saut, but tree growth is only seen near the river, and tends to disappear through lopping for firewood and browsing by camels.

We reached Halfa on the afternoon of the 23rd October, and Omdurman by steamer the same evening, passing Khartoum, which is being rebuilt and which lies almost opposite Halfa between the Blue and White Niles. "Khartoum" is Arabic for an elephant's trunk, to which the long narrow spit of land at high water between the two branches of the Nile bears some resemblance.

Omdurman is a treeless city of flat-roofed mud huts which, in the Khalifa's time, accommodated some 300,000 people; its

present population does not exceed a tithe of that number, and many of the houses are in ruins.

I took up my quarters at the Civil Mess for the few days I had to wait for a steamer going up the Blue Nile. The weather was still hot (92° F. inside a thick mud-walled house which, though comparatively cool during the day, retained the heat at night so that the temperature inside never fell below 86° F.). We slept in the open as far from mud walls as possible, placing our beds to catch any slight breeze there might be; the temperature in the early morning fell to 76° F. Except for sand-flies, which occasionally troubled us, we slept well enough.

The stock of timber in the wood market at Omdurman was neither extensive nor of good quality. I learned later by observation that the Arab is usually too lazy to go into the forest to cut, and *contents himself with such drift timber as comes to hand*. The want of means of transport has no doubt engendered this habit: no wheeled carts are used by the people throughout the Sudan; firewood is carried on camels and donkeys, but larger timber has to be transported on men's shoulders to a waterway. Prices ruled high for such inferior timber as was exposed for sale, and worked out to two shillings per cubic foot or more.

Leaving Omdurman on the 1st of November in the Government steamer "*Amara*," twelve days' steaming brought us to the end of the navigable Blue Nile at Roseires, a military station held by a *British officer with a few Sudanese troops*. A gunboat is stationed here by way of a fort, and there is telegraphic communication, a great advantage, as the mail usually arrives only once a month. A thoughtful Government has provided that throughout the Sudan Reuter's telegrams are transmitted to every telegraph station, and its officers are thus kept as far as possible in touch with the doings of the outer world. During the voyage up no opportunity was afforded of leaving the river bank; the river was falling, and delay would have meant risk of being stopped by shoals; there was therefore only time to attempt the estimation of the yield of fuel by measuring *stacks of firewood which had been felled on sample areas of one acre each in compliance with telegraphic instructions sent from Omdurman before starting*; the results were used as a basis for calculating the area required as fuel reserves for meeting Government needs.

We experienced a thunderstorm with strong wind and heavy rain on the night of the 2nd November, but otherwise had a pleasant run of 426 miles from Omdurman to Roseires. Crocodiles gave some rifle practice daily, and late one evening a lion was unsuccessfully shot at. The sandbanks were alive with thousands of cranes and pelicans, a few Nile geese were seen, *fish eagles were plentiful*, and hundreds of doves came down evening and morning to the river bank to drink. Hippo were first met with a little above the ruined town of Senaar (formerly the chief town on the Blue Nile), and guinea-fowl—the jungle fowl of the Sudan—were

seen in packs of fifteen to forty. A dense undergrowth of reeds and grass, reaching often 14 feet in height near the river bank, allowed little opportunity for seeing game so early in the season, but a glimpse was caught of a lesser kudoo, and three species of antelope (including the little Abyssinian "Dig-dig") were shot. Hyæna are plentiful, and lion were heard pretty often at night; traces of elephant and giraffe were seen.

The examination of the forest commenced from Roseires. The country south-east to the Abyssinian frontier at Famaka was first explored, and subsequently the forest on the banks of the Blue Nile down to Khartoum was examined.

The best forest on the Blue Nile lies to the south, where the rainfall is heaviest; on the lower reaches of the river tree growth is stunted, and large areas are destitute of trees. Generally there is a marked difference between the forest forming a belt along the river bank and the bush further back; the latter is largely Talha (*Acacia Seyal*), and is characteristic of black cotton soil throughout all parts of the Sudan. This acacia is a much branched tree of small size and produces an inferior gum of a dark colour. There are two varieties of the tree, *red* and *white* (the latter is distinguished as a variety *fistula* from its Arabic name *soffar*—a flute—given on account of its stipular spines being enlarged by the puncture of an insect, the larva of which on emerging leaves a hole in the globular enlargement on which the wind produces a flute-like sound). The two varieties are as easily distinguished at a distance by the colour of their bark, the former being of a rust red and the latter creamy white. The red variety is most plentiful and covers a greater area in the Sudan than any other individual tree. On poor soils the bush is composed chiefly of Kittur (*Acacia mellifera*) and La-ot (*Acacia nubica*). The belt of forest near the river may be divided into four parts. The most northern lying between Khartoum and the mouth of the Dindir river is characterised by Seyal (*Acacia spirocarpa*) and Haraz (*Acacia albida*). The only durable timber growing in this area is Saut (*Acacia arabica*), but it is too stunted and badly grown here to produce any timber. Such forest as remains is of value as a source of fuel, and the conservation as fuel reserves of 8 areas aggregating 33 square miles (which is practically the whole remaining wooded area between Khartoum and the mouth of the Rahad river) has been recommended.

From the mouth of the Dindir river to Singa, 116 miles Tarfa (*Tamarix articulata*), is the chief tree in the riverain belt; it attains a girth of 10 feet, and there are a good number of medium-sized trees; but straight timber is scarce. The ground is covered with a dense undergrowth 8 feet to 10 feet high of Moreib (*Penisetum unisetum*) which is used to a small extent for making mats.

From Singa to Sa-o-leil, 88 miles, Saut (*Acacia arabica*) is common, and yields a valuable timber which has been sought after

for boat-building and other uses, so that straight trees have been much cut out. On land inundated at high Nile this tree forms an unmixed forest, and from the nature of the ground forest fires have done little damage in such localities. Regeneration has however been prevented by excessive grazing; young seedlings spring up quickly in the soft mud left as the water recedes, but only to feed flocks of sheep and goats belonging to nomadic Arabs who travel south, as the Surait fly disappears in December and January. These people burn the coarse grasses ahead of them and play havoc with the forest; little escapes damage from fire, sheep, goats and camels.

From Sa-o-leil to the Abyssinian frontier a much greater variety of trees is met. Tarkar (*Sterculia cinerea*), Tabeidi (*Adansonia digitata*), Batanus (*Dalbergia melanoxylon*), Dom palm (*Hyphæne thebaica*), Silug (*Anogeissus leiocarpus*), Taraiya (*Pterocarpus lucens*), Luban (*Balsamodendron pedunculatum*), Gaffal (*Boswellia papyrifera*), Leyun (*Odina*, sp.), are common; Suderab (*Cordia Abyssinica*), a valuable timber tree, is found near watercourses, with Kakamut (*Acacia campylacantha*), which yields a durable hard wood. Siddr (*Zizyphus mucronata*) grows to a large size in these forests, and is specially plentiful on land cultivated before the troubled times of Dervish occupation swept the people from the country. Homeid (*Sclerocarpa* sp.) is common, and its timber is used for household utensils, but is not durable. Heglik (*Balanites egypitiaca*) is found here, and throughout the whole Sudan. Ardeib (*Tamarindus indica*) is indigenous, and is found widely scattered in the moister parts of the forest.

There is a dense undergrowth of tall grass, and the fires which result annually from the visit of the nomadic Arabs are extremely fierce. As a natural consequence most of the trees are badly grown and defective, and the canopy is much interrupted.

A solid-stemmed bamboo (*Oxytenanthera* sp.) was found growing on Mount Fazoghli opposite Famaka; hollow-stemmed bamboos were met with as drift in the Blue Nile, but were not found growing; probably they came from the Abyssinian hills. The more valuable timber trees are Kakamut (*Acacia campylacantha*), Saut (*Acacia arabica*), Inderab (*Cordia abyssinica*), and next in order Tarfa (*Tamarix articulata*), Silug (*Anogeissus leiocarpus*), Taraiya (*Pterocarpus lucens*), and Homeid (*Sclerocarpa* sp.). Dom palm (*Hyphæne thebaica*), which is very abundant in the Roseires district, will also furnish useful building timber.

The reservation of forest containing these trees on the Blue Nile has been recommended. It is specially desirable that every available area under Saut (*Acacia arabica*), which will yield timber of any size, should be reserved. Even at present there is a demand for this timber, and it is sure to be much in request for sleepers when railways are extended.

A start up the White Nile was made on the 5th January 1901, a country boat being used as transport, and the forest was examined on the way up.

For the first 175 miles to the town of Gozabu Guma, the forest is composed largely of Saut (*Acacia arabica*) on the low banks of the river which are inundated at high Nile. Haraz (*Acacia albida*) and Seyal (*Acacias pirocarpa*) are also common trees; large tracts of mere bush are met with composed of Kittur (*Acacia mellifera*), La-ot (*Acacia nubica*) and small Siddi (*Zizyphus spina Christi*), but a very small area bears forest capable of producing large timber of value.

From Gozabu Guma to Lake No Kuk (*Acacia verugera*), Heglik (*Balanites egyptiaca*), Dabka (*Oratava religiosa*), Siddr (*Zizyphus mucronata*), Kakmut (*Acacia campylacantha*) are the chief species found. Dom palm (*Hyphaene thebaica*), and Ardeib (*Tamarindus indica*) are occasionally seen. Talha (*Acacia Seyal*) is common on black cotton soil, bush of Kittur (*Acacia mellifera*) and La-ot (*Acacia nubica*) is extensive, and in many places behind the fringe of jungle lie vast grassy treeless plains. Ambach (*Herminiera elaphroxylon*) and Papyrus (*Cyperus papyrus*) line the banks and cover small islands in the river.

The reservation of all available forest on the banks of the White Nile up to Om Garr (125 miles above Khartoum) is required to provide fuel, and the reservation of some small areas capable of furnishing good Saut (*Acacia arabica*) has also been recommended; a timber reserve may also be formed near the hill of Ahmed Aga, where Kakmut (*Acacia campylacantha*) is to be found. Fuel reserves near the mouth of the Sobat river are also much needed, as steamers have there to take up a sufficient supply to carry them through the sudd region,—a run of 300 miles up the Bahr-el-Jebel. On the lower reaches of the White Nile sand grouse, hare, waterfowl, and doves are common. From Abbas island upwards guinea-fowl are plentiful, and a large red-legged partridge was occasionally shot. Duck, teal and geese continue plentiful; teal, specially so near Fashoda. Antelope are numerous; waterbuck *cobus leucotis*, gazelle, hartebeeste—in large herds of several hundreds near Lake No—little oribi and a few roan antelope were those noticed. Elephants are found in large herds south of Fashoda. Lion were heard at night on both banks of the river. Hyæna and leopard were also numerous; but the cover is too thick to see these animals as a rule. Buffaloes are found in small herds, and well worn paths made by them from the grass plains to the river bank were often crossed. Hippo in hundreds keep the river lively; they seem to be harmless enough; our boat was once bumped by one of these monsters, but probably it was unintentional. Crocodiles on every mud bank afford plenty of rifle practice. Handsome golden-crested cranes are seen in large flocks, and are by no means bad eating. Of birds of prey, vultures and

Marabout storks abound. The latter has in his tail some of the most beautiful small white feathers in the world. From a little north of Fashoda southwards Shulluks and Dinkas spend much of their time fishing in the shallow waters with a spear, the shaft of which is bent in a bow by a cord so that the stroke is circular and the spearhead is thus kept clear of the mud. A small round basket is also used by these people to catch fish. They spear hippo for food: first blood is drawn by a spear thrust on land, the native lying in wait beside a hippo path in the grass; attached to the spear is a piece of rope with a bit of "ambach" to act as a float. The spear shaft is detached when the thrust has been made and the hippo takes to the water with the spear in his side; he is followed up in canoes, the ambach float indicating his whereabouts when he dives; further spears are hurled at him whenever he comes to the surface to breathe, and the chase often lasts a long time before the hippo is worn out and killed.

The Sobat forests up to Nasser contain little of value, except as fuel. Kakamut (*Acacia campylacantha*) grows for 25 miles along the bank from the 140th mile up stream from the mouth of the Sobat river, and Heglik (*Balanites aegyptiaca*) grows to a large size as scattered trees in grazing country; these are the only species yielding durable timber. There is little or no forest for the first 100 miles up the Sobat, the banks being covered for miles with grass savannah; thereafter Kuk (*Acacia verugera*), Siddr (*Zizyphus mucronata*), Talha (*Acacia Seyal*) are plentiful, and furnish an abundance of fuel for the few steamers which go up the Sobat in the year. There is said to be good timber in the hilly country drained by the Baro, a large tributary of the Sobat, but that was far beyond the limit assigned to my exploration and is well inside Abyssinian territory. The chief game seen up the Sobat were waterbuck (*Cobus defassa*), *cobus leucotis*, giraffe, guinea-fowl and teal. Judging by the spoor, elephants are numerous during the rains. The cover afforded by the long grass at the time of my visit (end of January and early part of February) made it difficult to see game, and I was too busy to hunt for it. Snakes were common near the river, especially pythons, probably attracted by the rats, which swarmed in the long grass. With the exception of a black snake, 6 feet long, shot near the mouth of the Sobat river, no poisonous snakes were seen. Mosquitos in thousands were a great annoyance after sunset.

From Lake No up the Bahr-el-Jebel, the sudd region (a vast expanse of papyrus and reeds growing in what once was a large lake) is first traversed, and extends as far south as Kenissa, where forest of Kuk (*Acacia verugera*), Dabka (*Cratæva religiosa*), Heglik (*Balanites aegyptiaca*), Siddr (*Zizyphus mucronata*) is found on the banks, and Talha (*Acacia Seyal*) is generally behind. Some Eibnus (*Dalbergia melanoxylon*), badly grown, is found here and there. A small-leaved Inderab (*Cordia*

subopposita) is common; this species is found throughout the Sudan; it is a low-branched, crooked small tree, with a handsome fragrant heartwood. Similar forest extends to Uganda with patches of Dom (*Hyphaene thebaica*) and Doleib (*Borassus flabelliformis*) palms above Bor on the right bank.

The chief demand on the forest is for fuel, and a fuel reserve near Kenissa is required.

The journey up the Bahr-el-Jebel to Gondokoro was made by steamer, and the only opportunities of exploring the forest were halts for wooding, which did not allow of more than a few miles from the bank being seen. The "maiyahs," or open stretches of water in the sudd region off the main channel of the Bahr-el-Jebel swarm with hippo, who are here less disturbed than in the river. Herds of elephants are numerous where they find solid ground; they appear to dislike taking to the water even when alarmed by the approach of a steamer. If these animals can be captured and trained, a valuable and very much needed means of land transport will result, and the chief difficulty of travel in this region will be solved. The elephant-hunting done by natives has for its chief object a supply of meat: pitfalls and heavily weighted spears dropped from trees are the means employed; none of the meat is wasted; the internal fat is specially prized, and a number of natives struggling for it in the interior of a dead elephant is a sight to be remembered. South of the sudd region, besides elephant, rhino are occasionally seen, also lion. Of antelope, waterbuck are common, and pretty little bushbuck gives difficult shooting, as it bounds from thicket to thicket. Hartebeeste also are found. Baboons are numerous south of Kenissa, and it was a common sight to see the young baboons riding on their mothers' backs.

Leopard and buffalo complete the list of big game; guinea-fowl are common here as elsewhere; teal and spurwing geese were the waterfowl shot.

The sudd region is the home of that strange and rare bird, *Balaeniceps Rex*; it is a large slate-coloured bird, 4 feet high, with a big head and exaggerated flat beak. We counted sixteen of these birds a little north of Shambe, the only spot where we found them. Pelicans, ibex (two kinds), Marabout storks, herons, kingfishers, divers and fish-eagles are among the birds seen on the river. The water abounds with fish, the largest of which is the Nile perch; a specimen seen weighed 130lbs.; and the most curious is the *Polypterus*, a fish with lungs. The gunboat on which the journey through the sudd was made was commanded by a naval officer who has been in charge of the sudd cutting expedition, the object of which was to re-open the main channel of the Bahr-el-Jebel, which had become blocked here and there for miles by floating vegetation; the first step was to determine (by indications given by the current) where the true channel lay; then the papyrus and reeds having been cut and burnt, side cuttings were

made, stakes were driven in and wire hawsers attached, so that a block 10 feet square might be torn off by the steamer and towed downstream; the process is repeated until a channel of sufficient width for navigation is clear. One block of sudd remained to be cut through at the time of my visit, and to avoid it we had to steam through a shallow lake, and thus circumnavigated the obstacle. This remaining block is to be cleared this year, and it is expected that the regular passage of steamers every month to Gondokoro carrying mails will keep the passage open.

There is an idea that the peaty soil formed by the decomposition of papyrus and reed may be utilisable as fuel; but none seen on the trip was sufficiently free from clay for that purpose.

It is possible that the papyrus, which forms the greater part of the vegetation of the sudd region, may prove of economic value as a paper-making material; it reproduces annually, and practically an inexhaustible supply is obtainable at the cost of cutting and preparation. The temperature in the southern part of the Sudan in February averaged about 95° F. in the hottest part of the day and 70° F. a little before sunrise. The rains begin in March, and we experienced in that month one really wet day, preceded by some thunder-showers. The temperature up the Blue Nile in December, with a strong north wind blowing, averaged about 82° F. in the day and fell to 60° F. at night, and the dryness of the air made it feel colder than the thermometer indicated.

On the return journey we reached Ed-Duem on the White Nile on the 12th March 1901, and started next day for El Obeid and the Kordofan forests on a tour lasting six weeks. The chief object of this journey was to examine the gum forests and the method of working them.

The area in Kordofan within which the Hashab tree (*Acacia verec*) is found, is roughly 12,000 square miles, of which 2,500 square miles may be taken as more or less stocked with the tree, a further 2,500 square miles may be considered as unsuitable by reason of clay soil, Hashab requiring a ferruginous sand of friable consistency. On the rest of the area, though the soil is suitable, the tree is found in a too small quantity to be productive, and the greater part consists of Marakh bush (*Leptadenia spartium*) growing in grassy steppes. This bush produces an exceedingly strong, fine, silky fibre, and being very abundant should prove of considerable economic value. The young twigs of a grass, green colour, are full of a slightly bitter watery sap, and form a large part of the food of the gazelle, who are thus able to exist during the dry season in a waterless country where no dew falls. The Arabs plait these twigs on the bush into a noose in which gazelles get caught by the foreleg and fall a prey to the Arab, who hides near by.

The gum forest is divided into "genena" and "wady;" the former are selected areas nearest to the villages, and in them the Hashab (*Acacia verec*) trees are regularly treated with a view to the production of clean gum. Generally these genena (gardens) are composed entirely of *Acacia verec*; other species being cut out, as shade is undesirable.

Soon after the close of the rains men go through their "genena," removing dead branches to facilitate the subsequent collection of gum, and preparing the trees by removing the outer bark in short narrow strips 2 feet to 3 feet long and 1 inch to 3 inches wide. When carefully done, the wood is not exposed, being completely covered by a layer of liber.

When the trees have lost their leaves, the dry wind and heat of the sun slightly cracks the liber and gum begins to exude. Sixty days are allowed to elapse after barking before the gum is collected (January), and thereafter it is usual to pick every fourth day until the rains, when the first flush of leaves stops the exudation of gum.

For a poorly stocked "genena" of about 10 acres, near the northern edge of the gum tract, the owner stated that he obtained about 100lbs. at the first picking, 75lbs. at the second, 30lbs. at the third, after which an average of 50lbs. was obtained for several pickings, and the yield went on diminishing to 10lbs. at the close of the season. In April when I visited that "genena," the picking yielded 40lbs, and the owner's estimate for the season was 1,200lbs. to 1,500lbs. The best genena would produce nearly double this quantity for an equal area. The picking is done by women, and the gum is sold in the villages to Arab merchants who temporarily reside at some central village where the produce of the surrounding gum forest is collected.

The gum is packed in large sacks made from the liber of the Kittur (*Acacia mellifera*), which is very durable. A pair of sacks full of gum weigh 350lbs., a camel-load for transportation to the Nile, either to Omdurman direct or to Ed Duem and other river ports, whence the gum is shipped to Omdurman.

The camels on their way to the gum villages carry grain and barter goods, with which the merchants purchase gum. Dhurra (*Sorghum vulgare*) is the grain imported; it does not grow on the sandy soils of Kordofan, and is in request for making native beer, Merissa, drunk by all Sudanese.

Young *Acacia verec*, 8 feet to 10 feet high and 6 inches to 8 inches in girth, will produce gum; they are then three or four years old, and continue gum-producing until a dark heartwood is found when the tree is twelve to fifteen years old, and the production falls off.

The "genena" are claimed as private property by the people in possession. Care is exercised in the use of fire, and though no fire lines are cleared, most of the genena escape being burnt. A fire practically stops the production of gum for the rest of the season.



BARKING A GUM TREE.



PICKING GUM.

The "wady" forest is composed of *Acacia verec* which are not barked or tended, and comprises areas near villages on which gum trees are too scattered to make systematic treatment remunerative and areas too remote from villages and water to allow of frequent gum picking.

The gum obtained is called "hashab wady," and owing to impurities is rather darker in colour than that obtained from the "gardens," which is called "hashab genena." Wady gum is usually in pear-shaped pieces of variable size proportional to the time that elapses before it is picked.

The gum industry is one which is capable of great development as population increases and fresh villages and wells are available as centres from which to work. At present, owing to the devastation of Kordofan by the Dervishes under Mahmoud, the population is small, but the production of gum last season amounted to over 80,000 cwt., valued at over £80,000 in Omdurman.

The conversion of "wady" into "genena" and the improvement of existing "genena" by filling up blanks, will cause a very large improvement in the production and quality of the gum.

Better means of communication would do much to help the gum trade, and a light railway from El Obeid to the Nile through the gum tract would undoubtedly pay; it would at the same time set free the camels at present employed on the main lines of export to act as feeders to the railway, thus enabling a much larger quantity of gum to be transported.

The gum business is best left to private enterprise, but Government can assist it by help in digging wells and thus enable new villages to be established. The revenue derived by Government from the gum is considerable, amounting to 20 per cent. *ad valorem*, or about four shillings per cwt.

A hunt after a rubber-producing *Ficus* took me beyond the gum tract to the south-west of Kordofan; this tree appears to be a new species; only a few were seen; it was reported to be plentiful some 250 miles further south in the Nuba country, but there was unfortunately not time to go so far to verify the report.

To the west lies a well-less tract of country separating Kordofan from Darfur, in which the only water procurable is such as is stored during the rains in the hollowed-out trunks of Baobab trees, from which the water is drawn in the hot weather by means of a rope and bucket as from a well.

At Bara, a town some 40 miles north of El Obeid, the Ushar (*Calotropis procera*) has grown to a great size and is almost a tree. Some of the stems measured 3 feet in girth. Bara is also remarkable for a fine grove of limes (*Citrus medica*); generally throughout the Sudan fruit (except water melons) is not cultivated, and the want of it is much felt.

The game of Kordofan comprised the greater kudoo, a magnificent antelope with fine spiral horns, the Riel antelope

which is not very common, and the gazelle which abounds. Guinea-fowl, partridge, and sandgrouse are the chief game birds; duck, geese, teal, and a few snipe were seen at the Rabad lake, and never have I seen such numbers of doves as on the trees near this water.

The temperature during March, April, varied from 98° F. to 105° F. in the heat of the day, and the night temperature varied from 42° F. (the lowest reading during the whole tour registered on the early morning of the 21st March) to 78° F. This wide range of night temperature is explained by the varying conditions of cloud.

The end of April saw me back in Omdurman, having travelled over 4,600 miles since I left on the 1st November, six months of incessant travelling often done under rough conditions, but with plenty of interesting occupation and in perfect health.

Of the country, which time did not allow me to reach, the province of Kassala on the east is said to contain gum-producing forest of *Acacia verec*, and along the Athara river Dom palm (*Hyphaene thebaica* and small Saut (*Acacia arabica*) are reported to be the only trees met with.

The Bahr-el-Ghazal country, on the extreme south-west, probably contains little forest of value, judging from the writings of Dr. G. Schweinfurth, who very thoroughly explored that region in 1868—70.

There may possibly be some forest of value in the Nuba hills south of Kordofan.

It is obvious that the forests of the Sudan being situated so far from the sea, an export timber trade is not practicable, but for exactly the same reason the importation of timber is very expensive, and without a cheap timber supply the development of the country is difficult. There is, therefore, every reason to reserve sufficient areas of forest to provide for the growing wants of the Sudan, and this has been recommended in the official report. Protection of such areas from fire and grazing is of primary importance, and the appointment of a competent officer to direct the work of reservation and protection of the forests and the utilisation of their produce, is obviously necessary. What is true for timber is still more pressing in the case of wood fuel, as the forest which has to bear the strain has already been much damaged by improper fellings and unrestricted grazing.

The Sudan Government must look to its Director of Forests to shape its forest policy, and the appointment of an officer of the largest experience is desirable. Owing to the large deficit in the Sudan Budget, there is, apparently, a difficulty in obtaining sanction to new appointments, but it is hoped that this will not prevent the immediate appointment of a Director of Forests, from which an economy should result from the outset. A retired Indian Forest Officer of great experience and high qualifications has been



"GHENA" OF ACACIA VERREK.

found willing to undertake the work, and probably the new year will see him starting the Sudan Forest Department.

By the date of my return to Omdurman the weather was pretty warm, but the wind was still from the north and the temperature of 102° F. in the day falling to 75° F. at night was not unpleasant. After writing a report in Khartoum I left on the 13th for Cairo: the first part of the train journey was hot, reaching 114° F., but on nearing Wady Halfa the weather became much cooler owing to a storm further north, and I found Assouan, which has the reputation of being hotter than the Sudan, very bearable. A very interesting day was spent here visiting the big irrigation dam.

On reaching Cairo, Mr. E. Floyer, the chief of the Egyptian Telegraph Service, invited me to visit his casuarina plantations near El Gatta; his object is to grow casuarina for telegraph poles, and he has planted a considerable area with plants at three feet intervals; he has selected a piece of ground which becomes inundated by percolation from a canal at high Nile, and this saves much expense in irrigating. Plants raised in a nursery are put out in February when the water falls, and they are irrigated later by shadufs, which, for the small height that the water has to be raised, are the most economical means. The plantations have been very successful so far, and *Casuarina glauca*, *C. quadrivalvis*, *C. suberosa* and *C. Cunninghamii* are the species which promise best results. The funds at Mr. Floyer's disposal are small, and to help to pay for the experiment he grows sissal and extracts the fibre from it by machinery at a good profit; he also obtains some help by the sale of *Hyoscyamus muticus*, which grows readily and yields a good return. In company with Mr. Floyer I paid a visit to some plantations near Tel-el-Kebir; unfortunately Mr. Birdwood, in whose care the plantations are, was not able to accompany us, so we had not much opportunity of learning the object of the planting and the conditions under which it had been done. Casuarinas here were adversely affected by salt in the soil; a species of *Melia* grew very well; also *Robinia pseudacacia*; *Eucalypti* had suffered much from wind and numbers were hopelessly blown over. Much closer planting than had been adopted would be advantageous. Irrigation, which is absolutely necessary, was effected by means of a steam-pump.

The plantations at and near Ismailia were next visited. At Ismailia the main plantation consists of Casuarina planted some twenty five to thirty years ago, which have done very well, the trees having reached a height of 70 feet with girths varying from 4 to 7 feet. *Eucalyptus* and a few poplar, which are mixed with them, have also grown well. Further east there is a trace of salt in the soil, and *Casuarina*, *Eucalyptus*, and *Albizia Lebbeck*, which have been put out, are all badly grown; even *Tamarix articulata* has not succeeded. The last plantation visited was the original casuarina plantation made by Mr. Marchetti thirty years ago. This has been successful, except on a portion where the soil contains salt.

These plantations would have been the better for thinning some years ago; they prove, however, that *casuarina* will do well, provided the soil is free from salt, and would justify Government in placing more adequate funds in Mr. Floyer's hands for his plantations at El Gatta, where the greatest economy compatible with good work is exercised.

C. E. MURIEL.

Since this article was sent to press we have learnt that Mr. A. F. Broun, late of the Indian Forest Service, and for some time Conservator of Forests in Ceylon, has been appointed Director of Forests in the Sudan. We have much pleasure in congratulating Mr. Broun on his appointment.—
HON. ED.

Identification of Loranthaceæ by their Leaves.

IN almost all forests where the vegetation has been damaged by forest fires, the loranthaceæ abound; and if once they become established, they spread with great rapidity. It is not uncommon, therefore, to find forests almost ruined by these parasites. The vegetation, already weakened by the fires, becomes totally incapable of battling against the loranthaceæ; and as the better species are usually less abundant in sap than the inferior species, the former are the first that are killed out. It is useful, therefore, to make a study of these loranthaceous pests. But as they are usually classified by their flowers, and as the flowers only exist for a short period, it is advantageous to find out some other method of distinguishing them, for owing to the huge charges which a Forest Officer in India has to supervise, it is not always practicable to visit the localities of their ravages at a time when all, or perhaps any of them are in flower. The following classification is, therefore, an attempt to distinguish them by their leaves, or by such permanently existing parts as are likely to be available at the time of any inspection. As there are seventy-four of these parasites (according to Hooker's *Flora of British India*), it is not easy to identify them; but the present classification has afforded a certain amount of help to the undersigned, and it is hoped that it may be of use to others.

A. W. LUSHINGTON.

LORANTHACEÆ.

I.—Plants not di- or tri- chotomously branched:

- (A) Leaves opposite, subopposite, opposite and alternate or alternate.—*Loranthus* (all species except *L. elastica*.)

II.—Plants di- or tri- chotomously branched; leaves wholly opposite, reduced to scales, or O:

A.—*Leafless parasites*:

- (a) Stem O, but inconspicuous stock which ramifies within the bark, which the minute branches perforate, but scarcely rise above the surface.—*Arceuthobium*.

- (b) Bushes appearing prominently above the surface of the bark.—*Viscum* (four species.)

B.—*Leafy parasites*:

- (a) Hoary or tomentose shrubs.—*Notothixso*.
 (b) Glabrous shrubs.
 (i) Very slender shrubs, with sheathlike thickening at base of branches.—*Ginallia*.
 (ii) Shrubs without sheathlike thickening at base of branches.
 * Branches sparsely lenticelled; fruit red.
 Loranthus (*L. elastica*).
 * * Branches not lenticelled; fruit not red.—*Viscum* (eight species.)

LORANTHUS.

I.—Root parasites, terrestrial growth:

- (A) Leaves alternate and opposite, lanceolate, $1\frac{1}{2}$ "— $2\frac{1}{2}$ " obtuse or acute, penninerved.
 (a) Young parts rusty pubescent.—*L. ligustrinus*.
 (b) Quite glabrous.—*L. terrestris*.

II.—Branch and stem parasites:

- (A) Branchlets dichotomous.
 * Quite glabrous, branches stout, terete, smooth, pale brown, sparsely lenticelled; leaves all opposite, sessile, very thickly coriaceous, shape variable from orbicular to elliptic-oblong, obtuse, base acute, 3—5 plinerved; fruit ovoid, red, $\frac{1}{2}$ "— $\frac{3}{4}$ ".—*L. elastica*.
 (B) Branchlets not dichotomous, but triquetrous (3-angled):
 * Quite glabrous; branches terete $\frac{3}{4}$ " thick; branchlets very robust, triquetrous, with flat or concave faces $\frac{1}{3}$ " broad, smooth; leaves opposite, or whorled in threes, thickly coriaceous, broadly elliptic, 4"—6", often as broad, obtuse, base acute or rounded, nerves distinct; petiole very stout, $\frac{1}{2}$ "— $\frac{3}{4}$ "; fruit, $\frac{1}{2}$ ", ellipsoid, crowned by cupular calyx.—*L. trigonus*.
 (C) Branchlets neither dichotomous nor triquetrous:
 (a) Leaves all alternate.
 (i) Branches, and leaves beneath, rusty tomentose. * Branches stout, dark grey, terete; leaves oblong or obovate-oblong, 1"— $1\frac{1}{2}$ ", tip rounded, glabrous above, penninerved; petiole, $\frac{1}{3}$ "— $\frac{1}{2}$ ".—*L. tomentosus*.
 (ii) Branches, and young leaves beneath, soft grey or buff tomentose.

- * Rootstock creeping; branches slender; leaves slender orbicular or cuneate-obovate, $\frac{1}{2}$ "—1", penninerved, glabrous or grey pubescent or tomentose above; petiole $\frac{1}{8}$ "— $\frac{1}{4}$ "; fruit elliptic-oblong, $\frac{1}{2}$ ", puberulous.—*L. bracteatus*.
- ** Branches very stout, sparsely lenticellate; bark black, leaves obovate-cuneate $\frac{3}{4}$ "—2", 3-plinerved, dark and opaque above, glabrous or ashy pubescent beneath; petiole $\frac{1}{8}$ "— $\frac{1}{2}$ ".—*L. recurvus*.
- (iii) Glabrous except youngest parts; moderately robust.
 - * Glabrous except youngest buds; branches not robust, bark grey; leaves obovate-cuneate, $\frac{1}{2}$ "—1 $\frac{1}{2}$ ", 3-plinerved, variable in width, tip round or retuse, narrowed to petiole; petiole short; fruit oblong, $\frac{1}{3}$ ", with persistent cupular toothed calyx.—*L. cuneatus*.
 - ** Glabrous except buds; more robust than *L. cuneatus*; leaves obovate or obovate-cuneate, larger, broader and more thickly coriaceous than *L. cuneatus*, 1 $\frac{1}{2}$ "—2", 3-plinerved; petiole short; fruit oblong, glabrous.—*L. sclerophyllus*.
 - *** Young shoots and buds scurfily pubescent; habit of *L. sclerophyllus*, leaves very coriaceous, orbicular or orbicular ovate, 1 $\frac{1}{2}$ "—2" × 1"—2", 3-plinerved; fruit oblong, glabrous.—*L. suborbicularis*.
 - **** Branches terete, leaves linear or oblong, $\frac{3}{4}$ "—2"; tip rounded, nerveless, glabrous; petiole $\frac{1}{12}$ "— $\frac{1}{4}$ ".—*L. ligulatus*.
- (iv.) Quite glabrous, very robust.
 - * Branches terete, bark smooth, dark; leaves elliptic, oblong-lanceolate, or linear, 3"—5", variable in width, obtuse or subacute, narrowed to petiole; thickly coriaceous; striolate, nerves very obscure; petiole $\frac{1}{4}$ "— $\frac{1}{2}$ " stout.—*L. heteranthus*.
 - ** Branches terete, grey; leaves (rarely opposite), elliptic-oblong or lanceolate, rarely obovate, 2"—6", obtuse or acute, thickly coriaceous, nerves faint; petiole $\frac{1}{4}$ "— $\frac{1}{2}$ ", fruit oblong-obovoid, $\frac{1}{3}$ "; crowned by cupular unequal 5-lobed calyx-limb *L. pentandrus*.
 - *** Branches terete, grey, densely lenticellate; leaves elliptic or oblong, 3"—7" × 1 $\frac{1}{2}$ "—4", obtuse, nerves broad, distinct; petiole $\frac{1}{4}$ ", very stout; fruit ovoid-oblong, $\frac{1}{2}$ "; crowned by cupular calyx limb.—*L. crassus*.

(b) Leaves both alternate and opposite on same plant.

(i) Young branches tomentose, all parts puberulous.

* Branches slender; when old woody, terete with dark brown smooth bark and large lenticels; leaves elliptic, ovate or cordate, 4"—7", obtuse base acute, thin almost membranous, nerves very slender; petiole long $\frac{1}{2}$ "-1" *L. involucratus*

** Rusty tomentose; branches stout, long, terete lenticellate, bark pale; leaves ovate or ovate lanceolate; 3"—6"; acute or acuminate, base rounded or cordate, very coriaceous; nerves very faint; petiole $\frac{1}{4}$ "- $\frac{1}{2}$ "; fruit flagon-shaped, ovoid, long-necked, crowned, by 4-toothed calyx.—*L. coccineus*.

*** Branchlets, and leaves beneath scurfily tomentose; branches terete, bark dark, minutely lenticellate, of shoots rufous; leaves obovate-cuneate, 1"-2" young tawny on both surfaces, old glabrous on both, tip rounded, base narrowed to petiole, nerves few ascending; petiole very short; fruit $\frac{1}{2}$ "- $\frac{3}{4}$ "; gradually narrowed from truncate tip to base, which has an annular thickening just above bract, terete, scurfy.—*L. rhoplocarpus*.

(ii) Young parts rusty pubescent.

* Branches rather stout, bark grey, lenticillate; leaves oblong 3"-4", subacute both ends, glabrous, coriaceous, nerves distinct; petiole $\frac{1}{4}$ "- $\frac{1}{3}$ "; fruit turbinate $\frac{1}{3}$ ", top broad, subtruncate.—*L. umbellifer*.

** Bark almost black; leaves broadly ovate, larger and more coriaceous than *L. umbellifer*, base rounded or subcordate; petiole long $\frac{1}{2}$ "- $\frac{3}{4}$ "; fruit turbinate.—*L. elatus*.

(iii) Young leaves mealy or puberulous.

* Branches rather slender, terete, pale, bark rough; leaves elliptic, 1"-1 $\frac{1}{2}$ "; obtuse, base acute, coriaceous; petiole $\frac{1}{4}$ "- $\frac{1}{2}$ ", rather slender.—*L. Wightii*.

(iv) Glabrous; branches lenticelled.

* Branches terete, bark pale, dotted; leaves elliptic 2 $\frac{1}{2}$ "-4"; obtuse, base acute, penninerved, nerves slender; petiole $\frac{1}{2}$ ", stout; fruit $\frac{1}{3}$ ", ovoid, rugose.—*L. Wallichianus*.

** Very near *L. Wallichianus*, but leaves larger and broader.—*L. intermedius*.

*** Branches very stout, bark smooth, red-brown, lenticels few; leaves ovate or oblong, 3"-4"; obtuse, coriaceous, greenish brown above, red brown beneath, midrib strong, nerves slender; petiole $\frac{1}{4}$ "- $\frac{1}{2}$ "; fruit ellipsoid.—*L. Gardneri*.

*** Branches stout or slender, bark smooth, dark-brown, lenticels few, large; leaves orbicular or oblong, 3"-4", base cordate, rounded or acute, rather thin shining above; petiole $\frac{1}{8}$ "- $\frac{1}{3}$ ".—*L. lageniferus*.

(v) Glabrous; branches lenticelled or not; leaves more or less sessile.

* Large bush, branches terete, usually smooth, dark or light grey, lenticillate or not; leaves orbicular, oblong, elliptic or linear, 3"-10" \times $\frac{1}{2}$ "-5", obtuse, thickly coriaceous, variable in shape and veining, sessile or stout petioled $\frac{1}{4}$ "- $\frac{1}{2}$ "; fruit oblong, $\frac{1}{2}$ ", smooth, crowned with cupular calyx limb.—*L. longiflorus*.

** Very robust, branches very thick, terete, bark pale, smooth or lenticillate, leaves ovate, 4"-6", bullate, acute or acuminate, base round or subcordate, strongly penninerved, nerves many, arching, deeply, sunk and anastomosing, subsessile; fruit ovoid, $\frac{1}{2}$ ".—*L. lonchiphylus*.

[NOTE.—The bullate and strongly-nerved leaves are characteristic.]

*** Very stout, habit of large-leaved states of *L. longiflorus*, with oblique nerves, but leaves much thicker; leaves shortly petioled, elliptic, oblong or orbicular.—*L. sarcophyllus*.

(vi) Glabrous; branches not lenticelled, bark dark.

(vi) * Branches stout, terete, bark smooth, dark; leaves ovate or elliptic, 2"-4", acute or acuminate, penninerved, nerves very faint, very coriaceous; petiole $\frac{1}{2}$ "- $\frac{3}{4}$ ", rather slender; fruit ellipsoid, truncate.—*L. pentapetalus*.

** Branches stout, terete, brown; leaves obovate, elliptic, orbicular, cuneate, or obcordate, 3"-4" \times 1"-4", obtuse or retuse, midrib stout, nerves slender; petiole $\frac{1}{8}$ "- $\frac{1}{3}$ " stout; fruit globose ovoid.—*L. retusus*.

*** Branches stout, terete, brown; leaves narrowly oblong or elliptic, 1"-3", obtuse narrowed to petiole, flat, thickly coriaceous, nerves faint, oblique; petiole very short; fruit oblong or pyriform, $\frac{1}{3}$ ", smooth crowned by cupular calyx limb.—*L. memecylifolius*.

- (vii) Glabrous branches not lenticelled, bark light.
- * Branches robust, terete, bark pale, smooth; leaves oblong or ovate-lanceolate, 5"—7", acuminate, penninerved, nerves faint, spreading, very coriaceous, pale and shining above; petiole $\frac{1}{8}$ ", very robust.—*L. pulcher*.
 - ** Very robust, branches terete, smooth, bark grey; leaves elliptic or narrow-oblong, $2\frac{1}{2}$ "—3", obtuse, narrowed to petiole, margins undulate, very thickly coriaceous; petiole very short.—*L. elegans*.
 - *** Very robust, branches very stout, terete, smooth; leaves oblong, orbicular, elliptic or oblong-lanceolate, 3"—6" \times $1\frac{1}{2}$ "—4", obtuse, narrowed to petiole, penninerved, nerves few, raised on both surfaces, thickly coriaceous; petiole $\frac{1}{4}$ "— $\frac{1}{2}$ ", very stout; fruit oblong, $\frac{1}{2}$ ", smooth.—*L. neelgherrensis*.
- (c) Leaves subopposite.
- (i) Young leaves rusty pubescent or mealy.
- * Branches terete, bark dark, lenticellate; leaves oblong, or elliptic-ovate, or lanceolate, 2"—3", obtuse or subacute, base acute, penninerved, nerves very faint, coriaceous; petiole $\frac{1}{4}$ "— $\frac{1}{3}$ ", rather slender; fruit small, globose, crowned with cupular calyx.—*L. Hookeriana*.
- (ii) Quite glabrous; branches lenticelled.
- * Branches robust, bark pale, lenticillate; leaves ovate or elliptic, 3"—5", sometimes $3\frac{1}{2}$ " diameter; obtuse, penninerved, nerves slender, very coriaceous; petiole, $\frac{3}{4}$ "—1"; fruit ovoid, closely rugulose.—*L. obtusatus*.
- (iii) Quite glabrous; branches not lenticelled, bark dark.
- * Bushy, bark dark; leaves elliptic or lanceolate, 3"—5", often falcate, narrowed to petiole, nerves slender, fleshy, petioled; fruit ellipsoid glabrous.—*L. odoratus*.
 - * *Branches very stout, bark smooth, black, shining; leaves linear-lanceolate, 5"—7" \times $1\frac{1}{2}$ ", acuminate, base narrowed to petiole, penninerved, nerves many, horizontal, very obscure, very coriaceous, smooth, shining, flaccid; petiole $\frac{1}{2}$ ", stout.—*L. Parishii*.
 - *** Branches black opaque; leaves narrowly falcately lanceolate, 3"—5" \times $1\frac{1}{2}$ ", acuminate, base narrowed to petiole, 3-7-plinerved, nerves parallel, thinly coriaceous; petiole $\frac{1}{4}$ "— $\frac{1}{3}$ ".—*L. ensifolius*.
- (iv) Quite glabrous; branches not lenticelled, bark pale.

- * Branches terete, bark pale, leaves elliptic-lanceolate, 3"—7", candate acuminate, base acuminate, midrib strong, nerves very faint; firmly coriaceous petiole $\frac{1}{3}$ "- $\frac{1}{2}$ ".—*L. Brandisianus*.
 - ** Leaves lanceolate, or elliptic-lanceolate, 2½"—3", acuminate, tapering to petiole, nerves obscure, glaucous beneath; petiole short.—*L. hypoglaucus*.
 - *** Branches terete or obscurely angled; leaves ovate to elliptic-oblong, 4"—6", acuminate or cuspidate, base obtuse or acute, nerves obscure, coriaceous, shining on both surfaces; petiole very short and thick.—*L. formosus*.
- (d) Leaves all opposite.
- (i) Leaves and young parts tomentose, mealy or scurfy; generally white or grey.
- * Large shrub, branches stout, terete, usually closely lenticellate, bark dark-grey, branchlets and young leaves clothed with flocculent mealy, white tomentum (fugacious); leaves broadly ovate, or ovate-oblong, 2"—8", acute or obtuse, nerves distinct, arching, glabrous; petiole $\frac{3}{4}$ "-1"; fruit large, clavate.—*L. pulverulentus*.
 - ** Large bush, variable in pubescence, form and size of leaves; young shoots covered with soft white or rusty tomentum; bark smooth, or lenticellate, pale; leaves ovate, oblong, cordate or obovate, up to 3", obtuse or subacute, penninerved; nerves slender, glabrous or tomentose beneath, coriaceous; petiole 0- $\frac{3}{4}$ "; fruit pyriform $\frac{1}{4}$ ", tomentose.—*L. scurrula*.
 - *** Large bush with more copious white tomentum, and more rounded cordate leaves than *L. scurrula*; branches and leaves on both surfaces clothed with white or tawny appressed tomentum; leaves orbicular or very broadly obovate, 3", tip obtuse or rounded, base rounded or cordate; petiole $\frac{3}{4}$ "-1"; fruit $\frac{1}{4}$ " tomentose.—*L. cordifolius*.
- (ii) Leaves and young parts tomentose, mealy or scurfy; generally buff or yellowish.
- * Large shrub, branches stout, terete, buff or pale rufous tomentose, bark dark, sparsely lenticellate; leaves oblong, or ovate or linear-oblong, 2½"-4", obtuse, base acute, often bullate with recurved margins, nerves faint, glabrous pale-green, shining above, buff or pale rufous tomentose below, very coriaceous; petiole $\frac{1}{4}$ "- $\frac{1}{2}$ "; fruit ellipsoid, $\frac{1}{3}$ "- $\frac{1}{2}$ ", glabrescent.—*L. vestitus*.

- ** Branches stout, terete, sparsely lenticellate, bark grey; branchlets and leaves beneath clothed with fine cinnamon or tawny stellate tomentum; leaves oblong or ovate-oblong, $1\frac{1}{2}$ "-3", obtuse, base rounded, nerves most obscure, rigidly coriaceous; petiole $\frac{1}{4}$ "- $\frac{1}{3}$ "; fruit $\frac{1}{2}$ ", subumbellate or $\frac{1}{4}$ " pedicels, puberulous, and bearing naked orbicular pustulate tubercles.—*L. thelocarpus*.
- *** Branches slender, bark grey, mealy buff pubescent when young, not lenticellate; leaves oblong or orbicular, $\frac{1}{2}$ "-1", rounded at both ends or base cordate, nerves few obscure, buff mealy on both surfaces; petiole 0; fruit $\frac{1}{4}$ "- $\frac{1}{3}$ ", tip rounded, calyx limb bruncate.—*L. Stocksii*.
- (iii) Leaves and young parts tomentose, mealy or scurfy; generally rusty red.
- * Branches terete, bark smooth, dark or grey, minutely lenticelled; branches and leaves beneath clothed with rusty, scurfy tomentum; leaves elliptic, $1\frac{1}{2}$ "-4", uniform, obtuse, base rounded, nerves faint, glabrous above, rusty below, coriaceous; petiole $\frac{1}{5}$ "- $\frac{1}{4}$ ", villous; fruit pyriform villous.—*L. ferrugineus*.
- ** Small shrub, branches terete, closely lenticellate, slender; branchlets rusty and scurfily pubescent, leaves elliptic, $1\frac{1}{2}$ ", obtuse, nerves faint, spreading, thinly coriaceous, quite glabrous; petiole $\frac{1}{4}$ "- $\frac{1}{3}$ " slender; fruit characteristic, $\frac{1}{2}$ ", consisting of short ellipsoid head contracted into thin pedicel not thickened at base, scurfily pubescent.—*L. malaccensis*.
- *** Branches terete, smooth, not lenticellate, nodes distant thickened, branchlets rusty pubescent; leaves elliptic or obovate, 2"-3", obtuse, base acute, midrib strong beneath, nerves very slender, coriaceous; petiole $\frac{1}{4}$ ", slender.—*L. Maingayi*.
- (iv) Glabrous; leaves minutely impressed, punctate on both surfaces.
- * Branches terete, bark pale (obscurely puberulous); leaves ovate-lanceolate, $2\frac{1}{4}$ "-4", obtusely acuminate, base rounded or acute, almost nerveless, thickly coriaceous, sessile; fruit $\frac{1}{6}$ ", ellipsoid puberulous.—*L. Lobbi*.
- ** Branches terete, thickly lenticellate; leaves elliptic, $2\frac{1}{2}$ "-3", acute or acuminate, almost nerveless, thickly coriaceous, petioled.—*L. nodiflorus*.

(v) *Glabrous*; leaves not impressed punctate.

- * Branches stout or slender, pale, bark smooth or lenticellate; leaves elliptic-ovate, oblong or lanceolate, $3''-5'' \times 1\frac{1}{2}''-2\frac{1}{2}''$, subacute or acuminate, base acute (rarely rounded), nerves distinct, spreading, very coriaceous, polished above; petiole $\frac{1}{4}''-\frac{1}{2}''$; fruit long, oval $\frac{1}{4}''$, yellow, smooth. *L. ampullaceus*.
- ** Probably a form of *L. ampullaceus*, from which it differs in the narrower nerveless leaves and globose fruit—*L. globosus*.
- *** Branches stout, terete, bark pale, warted; leaves oblong-ovate or lanceolate $2''-3'' \times 1\frac{1}{2}''-2''$, acuminate, nerves spreading, thickly coriaceous; petiole $\frac{1}{4}''-\frac{1}{3}''$; fruit ellipsoid. *L. loniceroides* (and *L. capitallatus*).
- **** Probably a form of *L. loniceroides*, from which it differs by being more robust, with larger and longer petioled leaves (and in the flowers). *L. psilanthus*.
- ***** Large shrub, branches terete, bark pale; leaves ovate or oblong, $2''-3'' \times 1''-1\frac{1}{2}''$, obtuse (rarely cordate), nerves many spreading, moderately coriaceous; petiole $\frac{1}{2}''-\frac{3}{4}''$, slender.—*L. albidus*.

ARCEUTHOBIMUM.

I.—Minute green leafless parasite.

- (A) Leaves reduced to opposite scales.—*A. minutissimum*.

VISCUM.

I.—Branches always leafy.

- (A) Branches and branchlets terete.

- * Large green bush, branches jointed; leaves obovate-cuneate, $1''-2''$ broad or narrow, tip rounded, 3-5 nerved; very coriaceous, sessile; fruit $\frac{1}{4}''-\frac{1}{3}''$, white.—*V. album*.
- ** Large shrub; leaves obliquely ovate or falcate, $1''-5''$, variable in breadth, acute or acuminate, 3-5 nerved (often strong), rather thin; petiole short; fruit $\frac{1}{3}''$, yellow or brown.—*V. monoicum*.

- (B) Branches terete or angular, branchlets angled.

- * Branches terete, opposite or whorled, rather slender; leaves obovate, oblong or rounded, $\frac{1}{2}''-1\frac{1}{2}''$, obtuse or acute, base cuneate, 3-5 nerved, not thickly coriaceous, petioled; fruit linear-oblong, warted.—*V. verruculosum*.

** Branches terete or angled and grooved, often very slender; leaves obovate to elliptic-oblong and linear-oblong, rarely more than 1", often unequal, obtuse, base narrowed or rounded, 3-5 nerved, petioled; fruit $\frac{1}{3}$ ", globose, smooth, purple, copiously but minutely dotted.—*V. orientale*.

*** A stout form of *V. orientale*, with larger, very thickly coriaceous leaves, 2"—4 $\frac{1}{2}$ " long. *V. ovalifolium*.

**** A form of *V. orientale* with branches and branchlets acutely angled, and deeply grooved; leaves petioled, elliptic-oblong or rounded, much waved, 1", obtuse, 3-5 nerved.—*V. orbiculatum*.

II.—Branches sometimes leafy, sometimes leafless, terete.

* Dwarf, forming much branched tufts 6"—10" long and broad, often parasitic on other *loranthaceæ*; branches short, terete, very stout; leaves 0, or ovate, obovate, spathulate or orbicular, $\frac{1}{4}$ "-1", often as broad, concave, tip rounded, base cuneate; upper leaves smaller, linear-oblong; fruit ovoid.—*V. capitellatum*.

** Branches terete, very long and slender, 10"—18", striate; internodes 1"—2", nodes hardly swollen, not contracted; leaves 0 or few, sessile or petioled, obovate or linear-oblong, or cuneate, 1", tip rounded, base cuneate, obscurely 3 nerved, coriaceous; fruit subglobose, minute.—*V. ramosissimum*.

III.—Branches leafless, angular.

* Main stem terete, branches 10"—18", acutely 4— or more—angled, long and slender, nodes not swollen nor contracted.—*V. angulatum*.

** Pendulous, 2—3—chotomously branched shrub, branches flattened, internodes, 1"-2" \times $\frac{1}{10}$ "- $\frac{1}{3}$ ", striate and furrowed when dry, contracted at nodes; fruit subglobose, yellow, smooth.—*V. articulatum*.

*** Dwarf, rarely 6" densely tufted, branches flattened, contracted at nodes, internodes $\frac{1}{4}$ "-1", breadth variable; fruit ellipsoid $\frac{1}{10}$ "—*V. japonicum*.

GINALLOA.

I.—Branches always leafy; thickened at base like a sheath.

* Rather large parasite, stem terete, dichotomously branched; leaves obovate or obovate-oblong, 1 $\frac{1}{2}$ "-2", tip rounded, thickly coriaceous, obscurely 3-5 nerved; petiole very short, stout, flat; fruit elongate.—*G. andamanica*.

** Leaves linear-cuneate, $\frac{1}{2}$ "- $\frac{3}{4}$ ", tip rounded or emarginate, tapering to base, 5-nerved, thinly coriaceous; sessile.—*G. Helferi*.

*** Leaves linear, or narrowly linear-spathulate $\frac{1}{8}$ "- $\frac{1}{3}$ ", tip obtuse or retuse, tapering to base, nerves very obscure, thinly coriaceous, sessile; fruit ellipsoid, $\frac{1}{2}$ ".—*G. spathulifolia*.

NOTOTHIXOS.

I.—Hoary or tomentose dichotomously branched parasites.

* Much branched, branches slender, young tomentose; leaves orbicular, or broadly ovate, $\frac{1}{2}$ "- $\frac{3}{4}$ ", obtuse, 3-nerved, transversely veined, sunk above, glabrous above, densely ochreous woolly beneath, coriaceous; petiole $\frac{1}{8}$ "- $\frac{1}{4}$ ", woolly; fruit ovoid, $\frac{1}{8}$ ", white.—*N. floccosus*.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Note on the Setikhola Wire Ropeway.

By C. G. ROGERS, F.C.H.

Deputy Conservator of Forests, Darjeeling Division.

THE storm-burst of the 24th September, 1899, breached the Jorebungalow-Pashoke Cart Road near the second mile from Jorebungalow, and a huge landslip has resulted, which stretches right up to the top of the hill at Senchal.

This landslip has steadily increased in dimensions each succeeding year, and as there seemed to be no chance of making a cart-road across this slip for a number of years (probably at least seven), and as the fuel cut for the Commissariat Department has to be carried along this cart-road to Jorebungalow, it was considered advisable to throw a wire ropeway across the slip so as to allow of fuel being carried across it at all times of the year and to lessen the cost of transport.

In the cold weather the extra charge for carriage of fuel across the slip is Rs.3-2 per 100 maunds, while in the rainy season (1st June to 30th September) the cost is Rs.6-4 per 100 maunds.

LENGTH, GRADIENT AND DIMENSIONS OF THE ROPE.

A length of 1,500 feet of Craddock's improved patent crucible steel wire rope, 2 inches in circumference (Lang's patent 6 strand), was obtained.

The actual space between the points where the fuel is placed on the rope, and where it is taken off the rope, is 1,222 feet. The amount of rope going to the lower anchorage and wound round the drum is 138 feet, while that from the head of the wire rope to the upper anchorage is 140 feet.

The mean down-gradient is 4 degrees 20 minutes, the down-gradient of the rope at the upper end being $8\frac{1}{2}$ degrees and that at the lower end of the rope only 10 minutes.

To save manual labour in carriage the gradient was kept as low as practicable, the fuel having to be carried from the cart-road up to the head of the wire rope.

ANCHORAGES OF THE WIRE ROPE.

The anchorages had to be placed at safe distances on either side of the slip, so that they would be out of reach of any extension of the slip itself which might occur.

Upper anchorage.—The upper end of the rope was passed twice round the stem of a tree 6 feet in girth, in two directions, and then fastened to itself. At a distance of 140 feet from the tree a loading stage was constructed, the rope at this point passing over a wooden intermediate support to raise it a convenient distance off the ground in order to allow of the loads of fuel being placed on it.

Lower anchorage.—The lower end of the rope was wound round a roller placed horizontally; the two ends of the roller rest in two wrought-iron loops strapped on to the inclined uprights which take the strain of the rope when stretched. The upright on one side was the stump of an oak tree, on the other it consisted of two scantlings $6" \times 4"$, strapped together, to make a beam $12" \times 4"$. This beam was buried 10 feet in the ground, and a dry rubble revetment built up around it. The beam was inclined slightly away from the rope, and was tied with fencing strand wire No. 4 ($\frac{7}{8}"$ circumference) to a similarly situated scantling $6" \times 4"$ buried 10 feet in the ground and packed with well rammed stones. A strut was also added to resist the tendency of the rope to drag the beam over. The root did not require strengthening in any way.

The anchorage has proved to be quite strong enough, and shows no signs of yielding to the strain.

The roller consisted of a log 8 feet 2 inches long and 15 inches in diameter. Battens $6" \times 4"$ and $2\frac{1}{2}$ feet long were nailed around the centre of the log to increase its circumference to $7\frac{1}{2}$ feet on the part on which the wire was wound.

The wrought-iron loops in which the roller rests were 2 inches wide and $\frac{1}{4}$ inch thick. These were not strong enough and broke when the rope was strained, but their fracture has not affected the stability of the anchorage.

Eight iron bands $1\frac{1}{2}" \times \frac{1}{8}"$ thick were shrunk on to the roller near each end, on either side of the holes in which are placed the levers used in rotating the roller in order to prevent the roller from splitting under the cross strain to which it was subjected.

After leaving the roller, the wire rope passed over a steel bar fixed on to the top of a wooden support so as to raise the rope sufficiently off the ground to allow of the loads being taken off the rope at the level of the cart-road.

A wooden platform was constructed in front of this support as a standing place for the men employed in removing the loads from the rope.

SMALL WIRE ROPE.

A small wire rope was stretched across the slip to take back the empty carriers.

This consisted of $1\frac{1}{2}$ cwt. of best galvanized steel fencing strand wire (No. 4), $\frac{7}{8}"$ in circumference.

It was first stretched right across the slip to the upper end of the anchorage of the large wire rope. It broke while being stretched tight at the point where it was spliced in Calcutta. The longer of the two portions was subsequently re-erected with a shorter span of about 900 feet, and has stood.

The mean gradient of this small wire is 6 degrees 30 minutes, the gradient at the upper end being 11 degrees 20 minutes, and at the lower end 50 minutes.

METHOD OF PLACING THE LARGE WIRE IN POSITION.

The small fencing strand wire was first wound on to the roller at the lower anchorage to prevent entanglement, and was gradually unwound and one end carried straight across the slip by 20 coolies. The other end of this wire was attached to the end of the large wire rope, which was on a drum when purchased. The drum was then placed on a bar just in front of the roller of the lower anchorage, the ends of the bar resting on two forked uprights in which it rotated. The large wire rope was then passed round the roller, and gradually unwound and pulled across by means of the small fencing wire and then fixed as above described (see Upper Anchorage).

TIGHTENING OF THE MAIN WIRE ROPE.

The roller around which the large wire rope was wound had four holes in the same vertical plane, equidistant from each other, bored near either end of the roller. The holes were 2 inches square and were cut right through the log; in these holes two steel levers, 15 feet long and 2 inches in diameter (ending in eyes to which ropes could be fastened if necessary), were placed. These levers were found to be too heavy, and were subsequently cut down to 10 feet. One of the levers was placed in the hole which was nearly at the top of the roller, and then brought into a horizontal position, thus rotating the roller on which the rope was wound.

While this lever was held so that it could not move, another lever was then similarly put into a hole near the other end of the roller, and as soon as the strain of the rope was taken on to the second lever, the first one was removed from the roller. The second lever was then made to rotate the roller and the first one then brought into use, and the process repeated until the rope was strained so tight that the gradient at the lower end where it passed over the support was about 10 minutes down.

Great difficulty was experienced in straining the rope tight, as the levers, which were of wrought instead of cast steel, were not strong enough to take the strain, and bent. Eventually the rope was strained sufficiently tight to allow of the loads coming over, but it is not possible with the levers in stock to strain it any tighter.

When the rope was strained as tight as was necessary, a scantling was placed across the two supports of the roller, and one of the levers eased back slightly and allowed to rest against it. The lever being jammed tight against this horizontal scantling, keeps the main rope from unwinding.

SMALL WIRE ROPE.

This being a very light rope, was stretched from the upper end. The drum on which the large wire rope arrived was used to wind the small wire rope, which was then placed on a horizontal

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pole resting in two strutted forked uprights. The drum was rotated around this pole by means of 8 battens $3'' + 2''$ in section, 4 feet long, used like capstan bars. Coolies turned these bars round till the rope was sufficiently strained and the drum fixed by jamming two of the bars against a pole resting against the two forked poles in which the axis of the drum rotated.

CARRIERS.

The carriers used were obtained from Messrs. Marshall, Son and Company, and are tea-shoot carriers.

The carrier consists of a grooved wheel and a hook, to which the wood is attached. One end of the axis of the wheel ends in a head $1\frac{1}{2}$ inches in diameter. The axis is $\frac{3}{4}$ inch in diameter and the hook is slotted on to its other end. The upper portion of this hook, where it is fastened to the axis of the grooved wheel, consists of a bar $1\frac{1}{4}$ inch wide by $\frac{3}{4}$ inch thick. This bar is $3\frac{1}{4}$ inches long, and projects beyond the grooved wheel. The lower portion of the hook is 4 inches long, circular in section, and half an inch in diameter. The hook is so bent that the portion of the hook, to which the rope sling in which the fuel is carried, is exactly vertically below the centre of the grooved wheel.

The external diameter of the grooved wheel is $3\frac{3}{4}$ inches, the wheel is 1 inch wide, the rim of the wheel 0.15 inch thick, and the groove 0.4 inch deep. The grooved wheel is given 0.07 inch play between the head of the axis and the upper portion of the hook.

The grooved wheels were of cast-iron and the hook and axis of steel. The wheel was pierced so as to allow of the axis being freely oiled.

These carriers did not prove successful, as the rims of all the cast-iron grooved wheels chipped and broke. They got very heated travelling over the rope, and seemed to heat unequally, and pieces of the rim flew off. They were all useless within less than a fortnight. Wrought-iron was welded on to the broken grooved wheels locally, and the diameter of the wheel slightly increased. The carriers thus altered are now working satisfactorily.

WORKING OF THE ROPEWAY.

The load which can be sent over on one carrier is from 3 to 4 maunds. The fuel is placed in a rope sling, one loop of which is placed on to the hook of the carrier, which is then lifted and placed on the rope.

As a rule, the firewood just reaches the lower end of rope, but occasionally it sticks, when a second load with a light rope attached to it is despatched, and the two loads drawn in together.

Some loads travel faster than others, and impinge upon a heap of brushwood and earth, which brings them to rest.

COST OF WORKING.

The cost of the wire ropeway is epitomized as under :—

	Rs.	a.	p.
25 carriers at Rs.3-12	93 12 0
1,500 feet of Craddock's improved patent crucible steel wire rope, 2" circumference on wooden reel, and freight	367 0 0
Two steel straining bars	79 12 0
1½ cwt. of best galvanized steel fencing strand No. 4, railway freight and packing	34 8 0
Anchorage of wire rope and platforms and intermediate supports	222 7 5
Two wooden blocks for straining main rope (not yet used)	13 0 0
Two steel levers	34 0 0
Coir and Manilla rope for straps for fuel	43 11 0
Total	888 2 5

DARJEELING, } C. GILBERT ROGERS,
The 4th November, 1901. } Deputy Conservator of Forests.

**List of Trees, Shrubs, &c., to be found in the Jerruck
Division, Sind Forest Circle.**

CLASS I.—DICOTYLEDONS.

DIVISION I.—ANGIOSPERMS.

SUB-CLASS I.—POLYPETALE.

A.—THALAMIFLORE.

ORDER I.—RANUNCULACEÆ.

1. *Delphinium saniculæfolium*. --Along the Indus. The flowers are used in silk dyeing. (Uncommon.)

ORDER II.—ANONACEÆ.

1. *Anona squamosa*.—Vern. *Sharifa*.—Cultivated in gardens.—(The custard-apple.)

ORDER III.—MENISPERMACEÆ.

1. *Cocculus villosus*.—Vern. *Karsan*.—Common throughout the Division. The leaves macerated in water form a consistent green jelly, and the juice of the ripe berries makes a durable purple ink.—Stewart Graham.)
2. *C. Læva*.—Vern. *Kai*.—Common throughout the Division: said to be used as a partial substitute for hops in the manufacture of Indian beer.—(Murray.)
3. *Stephania rotunda*.—Common.

ORDER IV.—NYMPHÆACEÆ.

1. *Nymphaea lotus*.—Vern. *Kuni*.—Common in marshes.
Var N. pubescens (Hooker).—Both these varieties are to be found in tanks, pools, etc. The tubers are eaten both raw and roasted by the natives, and are much esteemed by them.

ORDER V.—PAPAVERACEÆ.

1. *Argemone mexicana*.—The Jamaica yellow thistle. Naturalised throughout India (Hooker). By roadsides and in fields for about a mile inwards along the Indus. Near Kotri, it covers large tracts. An oil is extracted from the seeds.

ORDER VI.—CAPPARIDÆÆ.

1. *Cleome viscosa*.—Vern. *Kathori*.—Throughout the Division; infrequent.
2. *Gynandropsis pentaphylla*.—Vern. *Kinro*.—Throughout the Division an oil is extracted from the seeds.
3. *Cudaba indica*.—Vern. *Khodab*.—Common (*Stræmeria tetranda*).
4. *Capparis aphylla*.—Vern. *Kirir*.—Occurs in the North of the Division, more especially in the Katiar Range. The wood is used for the knees of boats; also for rafters and for fuel.
5. *C. horrida*.—Vern. *Ardanda*.—Common.

ORDER VII.—CARYOPHYLLÆÆ.

1. *Saponaria Vaccaria*.—Vern. *Nambho*.—Very common. The mucilaginous sap of this plant is used as soap by the natives in washing clothes. It is also said to be a good therapeutic in cases of itch.—(*Gypsophila Vaccaria*.)
2. *Polycarpon Læflingia*.—Common.
3. *Polycarpæa spicata*.—Throughout the Division.—(*Polycarpæa staticæformis*.)

ORDER VIII.—PORTULACÆÆ.

1. *Portulaca oleracea*.—Common.
2. *P. quadrifida*.—In marshy places.—(*Illecebrum verticillatum*.)
3. *P. tuberosa*.—Vern. *Lunak*.—Common.

ORDER IX.—TAMARISCINÆÆ.

1. *Tamarix gallica*.—Vern. *Iye*.—Common. Very useful as firewood. The galls produced by the attacks of gall flies are used as a mordant and possess astringent properties.—(Murray.)
Var *T. indica*.—Common.
2. *T. dioica*.—Common; all along the Indus and on the sea coast.
3. *T. articulata*.—Vern. *Asri*.—To be found in the northern forests of the Division, and attains to a very fair size. The galls obtained from this tree are used in the same way as those from *T. gallica* as an astringent and as a dye. The wood is used in turnery. (*T. orientalis*.)

ORDER X.—ELATINÆÆ.

1. *Bergia odorata*.—In marshy grounds.
2. *B. estivosa*.—Common in marshes.
3. *B. ammannioides*.—In marshy ground.

ORDER XI.—MALVACÆÆ.

1. *Malva rotundifolia*.—Vern. *Chandiri*. Common: chiefly on the hills. The leaves and seeds are used in medicine.—(Murray.)
2. *Malva parviflora* (*Marsh mallow*).—Common throughout the Division.
3. *Sida rhombifolia*.—Vern. *Baraira*.—Common throughout the Division. (*S. cordifolia*.)
4. *Abutilon bidentatum*.—Vern. *Baraira*.—Common. A good fibre, useful in the manufacture of ropes, is obtained from the stems.
5. *A. muticum*.—Vern. *Baraira*.—Scarce; rope is made from the fibre obtained from the stem. *A. tomentosum*.
6. *A. fruticosum*.—Found throughout the Division. Scarce.
7. *Urena lobata*.—Throughout the Division in waste; the fibres are considered to be a fair substitute for flax.
8. *Pavonia glehniifolia*.—Throughout the Division. (*U. cordata*.)
9. *Hibiscus Trionum*.—Throughout the Division.
10. *H. furcatus*.—Throughout the Division.
11. *H. Gibsoni*.—Throughout the Division. Uncommon.
12. *Thespesia populnea*.—Vern. *Bhendi*.—Found only in gardens and as a road side tree. Hard durable wood; does not attain to any size. (The Portia tree.)
13. *Gossypium Stocksii*. (Stock's cotton tree).—A few at Clifton, near Karachi. Hooker says, that it seems probable that

"this may be the wild form of the plant cultivated as *G. herbaceum* and therefore the parent type of all the forms of Indian cotton."

ORDER XII.—TILIACEÆ.

1. *Grewia populifolia*.—Vern. *Gango*.—Common on the hills.
2. *G. salvifolia*.—Vern. *Bihul*.—Throughout the Division.
3. *G. asiatica*.—Vern. *Phalao*.—Cultivated in gardens for its fruit. (*G. villosa*.)
4. *Corchorus olitorius*.—Vern. *Bunpat*.—Found everywhere; a coarse cloth called Tat is made from the long silky fibres of the bark; also, paper and rope.
5. *C. Antichorus*.—Vern. *Madhiri*.—Very common. A camel fodder plant, very mucilaginous (*C. humilis*.)

B.—DISCIFLORÆ.

ORDER XIII.—ZYGOPHYLLÆ.

1. *Tribulus terrestris*.—Vern. *Trikandri*.—Common.
2. *T. alatus*.—Vern. *Nandi Trikantri*.—Common throughout the division.
3. *Sesuvium portulacastrum*.—Common.
4. *Zygophyllum simplex*.—Vern. *Putlani*.—A camel fodder plant.
5. *Z. coccineum*.—On rocky ground; eaten by camels and goats.
6. *Eugenia arabica*.—Vern. *Dranu*.—Common.

ORDER XIV.—RUTACEÆ.

1. *Peganum Harmala*.—Common.

ORDER XV.—SIMARUBEÆ.

1. *Suriana maritima*.—On the coast; a littoral shrub.

ORDER XVI.—MELIACEÆ.

1. *Melia azadirachta*.—Vern. *Nim*. Throughout the Division, usually as a roadside tree: was planted in the Sonda nursery and has established itself in the Sonda reserve.
2. *Melia azedarach*.—Vern. *Bakhan*.—The Persian lilac. Scarce. In gardens at Karachi, Kotri and Hyderabad.

ORDER XVII.—RHAMNEÆ.

- 1.—*Zizyphus Jujuba*.—Vern. *Ber*.—Common.
2. *Z. vulgaris*.—Common.

ORDER XVIII.—ANACARDIACEÆ.

1. *Mangifera indica*.—The mango.

C.—CALYCIFLORÆ.

ORDER XIX.—LEGUMINOSÆ.

1. *Crotalaria Burhia*.—Vern. *Dranu*.—Found throughout the division. The fibres are used in the manufacture of rope.

2. *Cyamopsis psoralioides*.—Vern. *Gowri*.—Found wild everywhere in hedges, etc. Is largely cultivated for its young and tender legumes, which are used as a vegetable.

3. *Indigofera paucifolia*.—Vern. *Nir*.—Everywhere in the plains; a blue dye, resembling indigo, is obtained from it.

1. *Parviflora*, *I. semitrijuga*, *I. argentea*, *I. anabaptista*.—All common in the plains. It is from these plants that the blue dye so commonly used by Sindhis is obtained.

4. *Tephrosia tenuis*.—Common. The twigs are used as tooth-brushes by natives.

T. purpurea, *T. pauciflora*.—Common. The twigs of *T. purpurea* are used in making baskets, etc.

5. *Butea frondosa*.—Vern. *Palas*.—Uncommon in a wild state; is grown in gardens.

6. *Caesalpinia Bonducella*.—Vern. *Kirbat*.—(The fever nut plant.)—Common in hedges and in waste. The bark and nuts are powerfully tonic and are employed in fever cases by native practitioners. (The nicker nut.)

7. *Poinciana regia*. The gold Mohr.—In gardens.
P. elata.

8. *Parkinsonia aculeata*.—Vern. *Vilaiti Kikar*.—Found in hedges and on roadsides. A native of the West Indies.

9. *Cassia Fistula*.—Vern. *Cham-kani*. Planted in gardens.

10. *C. auriculata*.—Vern. *Chowan*.—Common. The bark is used by tanners and the roots by workers in iron and steel. The twigs are used as tooth-brushes. (*C. obovata*.)

11. *C. Absus*.—Vern. *Chowan*.—Common.

12. *Tamarindus indica*.—The tamarind. Common in gardens and near villages.

13. *Bauhinia purpurea*.—In gardens.—(*B. variegata*.)

14. *Prosopis spicigera*.—Vern. *Kandi*.—Next to babul, the chief forest tree in the Division; attains to a considerable height and girth. Useful principally as firewood.

15. *Dichrostachys cinerea*.—Uncommon; have got it at Sonda.

16. *Mimosa rubicaulis*.—Vern. *Hajero*. (One of the mouths of the Indus is called the *Hajero*), Common: along the river and on the banks of canals.

17. *Acacia farnesiana*.—Vern. *Vilaiti kikar*.—Common.

18. *Acacia arabica*.—Vern. *Bābār*.—The forest tree of the division. (The babul.)

19. *A. Jacquemontii*.—Vern. *Kandiari*.—Common.

20. *A. eburnea*. Vern. *Kikar*. Common: in stony lands.

21. *A. Catechu*.—Not indigenous: attempts—not very successful ones—have been made to introduce this as a forest tree but it does not seem to be able to resist the cold.

22. *A. Senegal*.—Vern. *Khair*.—Common ; especially on the hills.

23. *Albizia Lebbek*.—Vern. *Sirras*.—Occurs principally as a roadside tree.

24. *A. odoratissima*.—In gardens.

25. *Pithecolobium dulce*.—Planted at Sonda, Hazari, Katiar, etc., but does not thrive.

ORDER XX.—RHIZOPHOREÆ.

1. *Rhizophora mucronata*.—Vern. *Kamo*.—Common along the banks of the Indus. The bark is used in tanning.

2. *Ceriops Candolleana*.—Vern. *Chauri*. (*The mangrove*).—Common all along the coast, salt-water creeks and the mouths of the Indus. The bark, roots and fruit are used in tanning.

3. *Bruguiera gymnorhiza*.—Common along the banks of the Indus near the sea coast. The bark is used in dyeing and produces a black.

ORDER XXI.—MYRTACEÆ.

1. *Psidium Guyava*. (*The Guava*).—Cultivated.

2. *Eugenia Jambolana*.—Vern. *Jamni*.—Cultivated in gardens.

ORDER XXII.—LYTHRACEÆ.

1. *Lawsonia alba*.—Vern. *Manidi*.—Cultivated as a hedge plant.

2. *Lagerstrœmia Flos Regine*.—Have only got it at Jerruck.

3. *Sonneratia acida*.—Vern. *Tiwar*.—Very common in the delta of the Indus.

ORDER XXIII.—CUCURBITACEÆ.

1. *Cephalandra indica*.—Vern. *Kanduri*.—Found everywhere.

2. *Mukia scabrella*.—Vern. *Bellari*. (*The bristly Bryony*).—Very common ; is found in rubbish heaps and in hedges.

3. *Ctenolepis cerasiformis*.—Found everywhere ; is eaten by cattle.

ORDER XXIV.—CACTEÆ.

1. *Opuntia Dillenii*.—Vern. *Chappal*.—The broad-leaved prickly pear. Naturalised. In dry stony places. A downright nuisance.

ORDER XXV.—FICOIDEÆ.

1. *Sesuvium Portulacastrum*.—Common on the sandhills along the sea shore.

2. *Trianthema monogyna*.—Vern. *Narmak*.—Common ; on waste ground in the plains.

3. *T. crystallina*.—Vern. *Waho*.—Common ; a camel fodder plant.

4. *T. pentandra*.—Vern. *Narmak*. Common all over the plains. A camel fodder plant.

5. *T. hydasgica*.—Vern. *Fysar-lani*. A camel fodder plant.
6. *Mollugo hirta*.—Vern. *Kothak*.—Throughout the Division.
7. *M. stricta*.—Throughout the Division.

SUB-CLASS II.—GAMOPETALÆ.

ORDER XXVI.—RUBIACEÆ.

1. *Oldenlandia corymbosa*.—Very common ; a weed.
2. *O. retrorsa*.—Near Karachi.

ORDER XXVII.—GOODENOVIÆ.

1. *Scaevola Kœnigii*.—Common on the sea shore near Karachi and in the delta of the Indus.
2. *S. Lobelia*.—Common on the sea shore.

ORDER XXVIII.—MYRSINÆ.

1. *Egiceras majus*.—Vern. *Chawer*.—Common in salt marshes and on the shore.

ORDER XXIX.—OLEACEÆ.

1. *Olea cuspidata*.—Vern. *Khoso*.—Uncommon. The wood is very hard and heavy and takes a good polish : used in turnery and for making combs.

ORDER XXX.—APOCYNACEÆ.

1. *Rhazya stricta*.—Vern. *Suir*.—Throughout the Division. A tonic infusion is made from the leaves.
2. *Nerium odorum*.—Along the banks of rivers, etc. ; also cultivated in gardens. There are several varieties, white, red, etc. ; also double and single. Very poisonous. Camels sometimes eat the leaves, which always prove fatal. " Perhaps only a variety of *N. oleander* of the Mediterranean region which extends eastward to Persia."—(Hooker.)

ORDER XXXI.—ASCLEPIADEÆ.

1. *Periploca aphylla*.—Vern. *Barai*.—Common.
2. *Oxystelma esculentum*.—Vern. *Dudhi*.—Common ; found climbing on milk-bush hedges, etc. Is browsed by cattle.
3. *Calotropis gigantea*.—Vern. *Ak*.—Common ; grows in the very poorest soil known as the Chinese silk plant. The fibres of the plant are used in the manufacture of twine and fishing nets.
(*C. procera*.)
4. *Dæmia extensa*.—Vern. *Khariāl*.—Very common as a hedge plant ; is usually found near *C. gigantea*.
5. *Sarcostemma intermedium*.—Vern. *Soma*.—Common. The juice has a very acrid taste, and the plant is said to be very antipathetic to white-ants.

ORDER XXXII.—BORAGINÆÆ.

1. *Cordia Myxa*.—Vern. *Gidora*.—Found at Sonda and neighbourhood on both sides of the river.
2. *C. Rothii*.—Vern. *Lyar*.—Common. The wood is useful for building and for carpenter's work. The fruit is largely eaten by the natives.
3. *Heliotropium Eichvaldi*.—In the plains, frequent. One of the few European plants found in Sind.
(*H. calcareum*, *H. ovalifolium*.)
4. *H. rariflorum*.—Near Karachi.
5. *Trichodesma africanum*.—Vern. *Pabūrpani*.—The leaves are used in medicine.

ORDER XXXIII.—CONVOLVULACEÆ.

1. *Ipomœa hederacea*.—Vern. *Hab-ul-nil*.—Abundant.
2. *I. biloba*. (*The goat's-foot creeper*.)—Found in Karachi ; is being planted along the Indus by the Forest Department on the sanddunes and by the Public Works Department along their banks.
3. *Convolvulus arvensis*.—Vern. *Haran-pag*.—The deer's-foot convolvulus. Very common.

ORDER XXXIV.—SOLANACEÆ.

1. *Solanum sarmentosum*.—To be found all over the plains in all soils.
- S. *Melongena*.—Cultivated frequently. (*S. trilobatum*.)
2. *Physalis minima*.—Vern. *Baiman*.—Common.
3. *Withania somnifera*.—Common.
4. *W. coagulans*.—Vern. *Panir-jo-photo*. Common. This shrub has light coloured leathery leaves, densely covered with short stellate hairs arranged in tufts. They are used to curdle milk, whence the native name of "panir" or cheese. (Murray.) "The cheese-maker." (Hooker.)
5. *Lycium europæum*.—Vern. *Gangro*.—Common. Browsed by camels and goats.
6. *L. barbarum*.—"Doubtful whether it should be separated specifically from *L. europæum*." (Hooker.)
7. *Datura fastuosa*.—Vern. *Dhaturo*.—Common ; in waste places ; a weed.
(*D. alba*.)

ORDER XXXV.—SCROPHULARINÆÆ.

1. *Linaria ramosissima*.—Common in stony places.
2. *Schweinfurthia sphaerocarpa*.—Vern. *Sonepat* (*Snapdragon*).—Common in stony places.
3. *Lindenbergia abyssinica*.—Common in stony places.
4. *Peplidium humifusum*.—Common near tanks and in moist places.
5. *Campylanthus ramosissimus*.—On the limestone hills between Hyderabad and Katiar.

ORDER XXXVI.—BIGNONIACEÆ.

1. *Tecoma undulata*.—Vern. *Lohiro*.—To be found in the hills ; the timber is hard and close grained.

ORDER XXXVII.—ACANTHACEÆ.

1. *Justicia simplex*.—Vern. *Nazpat*.—Found in waste.

ORDER XXXVIII.—VERBENACEÆ.

1. *Lantana indica*.—Common.
2. *Lippia nodiflora*.—Vern. *Wakem*. Found in moist situations ; would probably be useful if encouraged along the river (Indus) banks, as it gives consistency to the soil.
3. *Priva leptostachya*.—In moist situations.
4. *Clerodendron phlomoides*.—Vern. *Gharait*. In hedges ; a large bush. There are two varieties, one with white, the other with red flowers. (*Nairne gives white only*.)

ORDER XXXIX.—LABIATÆ.

1. *Ocimum basilicum*.—Vern. *Nazbo*. The common sweet basil. Indigenous ; usually cultivated.

SUB-CLASS III.—MONOCHLAMYDEÆ.

ORDER XL.—NYCTAGINEÆ.

1. *Boerhaavia vesticillata*.—Vern. *Nakbel*.—Very common ; somewhat of a pest to cultivators, as it has long fusiform roots penetrating deeply ; is greedily eaten by goats, camels and cattle.
2. *B. elegans*.—Scarce ; only found in the north of the division.

ORDER XLI.—AMARANTACEÆ.

1. *Celosia argentea*.—Vern. *Survati*.—A common field weed.
2. *Digera arvensis*.—Vern. *Taudala*.—Common. Used as a pot herb. (Murray.)
3. *Amarantus tenuifolius*.—A field weed.
4. *Cyathula prostrata*.—Vern. *Dayal*.—Common.
5. *Achyranthes aspera*.—Vern. *Margio*.—A troublesome weed, to be found everywhere in the open. When incinerated, it yields a considerable quantity of potash. Used in cases of scorpion stings and punctures caused by babul thorns.
6. *Alternanthera sessilis*.—Vern. *Samki*.—A common weed ; greatly esteemed as a pot herb by the natives. (Murray.)

ORDER XLII.—CHENOPODIACEÆ.

1. *Chenopodium album*.—Vern. *Shil*. (The white goose-foot.)—Common.
2. *Atriplex Stocksii*. Common in salt marshes.
3. *Arthrocnemum indicum*.—Common in the salt marshes, near Karachi and Ketī Bandar ; furnishes an alkali used in the manufacture of soap and glass.

4. *Sueda fruticosa*.—Vern. *Lani*.—Abundant. A crude soda is made from this plant.

5. *Sueda maritima*.—Vern. *Khari Lani*.—Found throughout the Division, more especially in the Mulchand and Penah Ranges. An impure carbonate of soda (*Suji khar*) is obtained from it by incineration; it is used in soap-making, calico dyeing, washing, etc. The plant is the favourite food of the camel.

6. *Basella rubra*.—Vern. *Poi*.—Common. This and a variety (*B. alba*) are cultivated and used as pot herbs. The *baji* of the Anglo-Indian breakfast table.

ORDER XLIII.—POLYGONACEÆ.

1. *Calligonum polygonoides*.—Vern. *Phog*.—Common.
2. *Rumex dentatus*.—A weed used as a pot herb by the natives.
3. *R. vesicarius*.—On the hills; is sometimes cultivated.

ORDER XLIV.—EUPHORBIACEÆ.

1. *Euphorbia thymifolia*.—Vern. *Dodak*. Very common.
2. *E. Tirucalli*.—Vern. *Sair*.—The milk-bush. Very common.
3. *E. neriifolia*.—Vern. *Thur*.—The common prickly pear. A pest.
4. *Phyllanthus reticulatus*.—Vern. *Kamo*.—A large scandent shrub; very common. A forest pest.
5. *P. Niruri*.—Vern. *Niruri*.—Common.
6. *Flueggia microcarpa*.—Common.
7. *F. leucopyrus*.—Vern. *Kiran*.—Common in open situations.
8. *Chrozophora tinctoria*.—Infrequent.
9. *C. obliqua*.—Infrequent.
10. *C. plicata*.—Vern. *Sibali*.—Infrequent.
11. *Mallotus philippinensis*.—Infrequent; yields the powder for the *Kamala* dye used in colouring silk.
12. *Ricinus communis*.—Vern. *Erandi*. (Castor-oil plant.)—Common; cultivated.

ORDER XLV.—URTICACEÆ.

1. *Morus alba*.—Cultivated in gardens.
2. *M. indica*.—Cultivated in gardens: a shrub.
3. *M. laevigata*. Cultivated in gardens.
4. *Ficus bengalensis*.—Vern. *Wad*.—Common.
5. *F. religiosa*.—Vern. *Pipar*.—Common.

ORDER XLVI.—CASUARINEÆ.

1. *Casuarina equisetifolia*.—The beef wood of Australia. Planted at Malir, near Karachi; a good many also in Karachi, Kotri, Hyderabad, etc., along roadsides and in gardens.

ORDER XLVII.—SALICINÆ.

1. *Salix tetrasperna*.—Vern. *Sufaida*.—Uncommon; usually in gardens.
2. *S. acmophylla*.—Vern. *Budka*. Fairly common in Upper Sind, but scarce in Jerruck. Cultivated.
3. *Populus euphratica*.—Vern. *Bahan*.—All along the banks of the Indus, chiefly in the Ketī-Mehrani Reserve; is more often met with in the northern than in the southern part of the Division. Useful for rafters and for turnery; the lacquered boxes, etc., made in Sind, are made from this wood. The twigs are used by the natives as tooth-brushes.

DIVISION II.—GYMNOSPERMS.

ORDER XLVIII.—GNETACEÆ

1. *Ephedra peduncularis*.—Common in the open.

CLASS II.—MONOCOTYLEDONS.

ORDER XLIX.—COMMELINACEÆ.

1. *Commelina benghalensis*.—Common on high lands. The leaves are eaten by the poorer classes.
2. *C. obliqua*.—Vern. *Khana*. Used for both of these herbs.
3. *C. albens*.—Common.

ORDER L.—PALMÆ.

1. *Phoenix sylvestris*.—Vern. *Kajur*.—The wild date. Not very common. A good many in the neighbourhood of Tatta; would repay cultivation.

ORDER LI.—TYPHACEÆ.

1. *Typha elephantina*.—Vern. *Pan*.—Scarce. On the banks of the Indus at Shal, Kinjar and Dhabiar in the Viran range, at Manjband in the Shah Bandar range, and at Ketī Bandar at the mouth of the Indus; at the lastmentioned place, in fair profusion. I have got it also at Tikur in Katīar and Kalan Kot near Tatta. Has long and tortuous roots, which penetrate deeply into the soil. Ropes, mats, baskets, and rude boats are made of this grass, and the pollen is made into "bur," a confection much desiderated by Sindhis. (The elephant grass.)

ORDER LII.—CYPERACEÆ.

1. *Cyperus conglomeratus*.—Vern. *Chio*.—In moist places. *C. pygmaeus*. (*Juncellus pygmaeus*.)
2. *Remirea maritima*.—Vern. *Lanissa*.—In salty places throughout the Division. The plant contains an abundance of saline matter.

ORDER LIII.—GRAMINÆ.

1. *Paspalum sanguinale*.—Vern. *Karash*.—Found everywhere; a good fodder grass.
2. *P. pennatum*.—Near Karachi and as far as Jungshahi.

3. *Saccharum spontaneum*.—Vern. *Khan*.—Common throughout the forests, especially in the Shah Bandar range; very inflammable.

4. *S. arundinaceum*.—Vern. *Sar*.—The *munj* grass. Common all along the banks of the Indus. Rope is made from the fibre obtained from the culms and leaves.

5. *Ischæmum aristatum*.—Vern. *Dainu*.—Plentiful everywhere; excellent as fodder.

6. *Andropogon Ischæmum*.—Vern. *Khai*.—Abundant throughout the forests.

7. *A. contortus*.—Vern. *Suriali*. (*Heteropogon Lisboa*.)—The spear grass. Common everywhere. Is good as fodder when young, but after seeding the awns hurt the mouths of animals.

8. *Aristida hystriacula*.—A good fodder grass.

9. *Cynodon dactylon*.—Vern. *Huriali*.—Found everywhere; the best available fodder.

10. *Eleusine flagellifera*.—Vern. *Chabari*.—To be found everywhere. A good pasture grass.

11. *E. ægyptiaca*.—Vern. *Chabar*.—Plentiful along the banks of the Indus. A very nutritious pasture grass.

12. *E. aristata*.—Plentiful.

13. *Phragmitis Karka*.—Vern. *Sar*.—Extremely common, especially in the Mulchand and Jurar Reserves. Chairs, baskets and other articles are made from the stems, and a soft rope from the fibre obtained by macerating and beating the flower stalks. Very dangerous in forests, as it is highly inflammable.

14. *Eragrostis cynosuroides*.—Vern. *Dub*.—Throughout the forests, usually on the higher lands. Very common on the bands of the Irrigation Department.

Note.—In compiling this list, I have consulted the following authorities:—

1. *Flora of British India*: Hooker.
2. *The Flowering Plants of Western India*: Nairne.
3. *List of Trees, Shrubs and Woody Climbers of the Bombay Presidency*: Talbot.
4. *The Plants and Drugs of Sind*: Murray.
5. *A Catalogue of the Flora of Mahableshvar and Muticran*: Birdwood.

I do not by any means claim completeness, and there are many plants which I have overlooked, but it is an attempt, in a small way, to describe the flora of the Jerruck Division—the only one in Sind in which I have worked—which will, I trust, prove both interesting and useful.

G. K. BETHAM,
Divisional Forest Officer, Jerruck.

VI.—EXTRACTS, NOTES AND QUERIES.

Timber and Forestry in Western Australia.

WESTERN AUSTRALIA has of recent years come largely before the eyes of the world on account of the important auriferous districts which have been discovered and opened up, such, for instance, as Coolgardie; but another source of prosperity to this colony is the ever-increasing exploitation of her vast timber wealth, with which Europe has become practically acquainted only within the last half decade. The forests are virtually all situated in the south-western division of the country. It is only there that the great commercial-timber trees grow, although there are timber belts in much of the country outside that region which are in great demand in local markets. The areas on which the principal trees grow have been carefully calculated, and are as follows:—

	Acres.
Jarrah, chiefly (with blackbutt and red gum) ...	8,000,000
Karri	1,200,000
Tuart	200,000
Wandoo	7,000,000
York gum, yate, sandalwood, and jam ...	4,000,000

Total area of the principal forest surface of 20,400,000
Western Australia.

The trees above enumerated are the principal staples of the timber industry of the colony, in addition to which, however, are wattle (*Acacia Saligna*), banksia (of which seven varieties are classified), sheoak (*Casuarina Fraseriana* and *Casuarina glauca*), morrell (*Eucalyptus longicornus*), salmon gum (*Eucalyptus salmonophloia*), blue gum (*Eucalyptus megacarpa*), gimlet gum (*Eucalyptus salubris*), and others of minor importance.

Apart from the undoubted excellence of the timbers above enumerated, an interesting and, financially, a valuable feature of West Australian forestry, is the fact that large quantities of the same species of tree grow on considerable areas without any material intermixture of other species. This is of very great advantage to timber-cutters, as it tends to lessen very materially the working expenses of removing machinery, and other expenses connected with securing large quantities of one particular kind of timber. The timber trees are chiefly gregarious. This is particularly the case with jarrah and karri; although, as a rule, the former is found forming a sort of fringe to the latter, but never *vice versa*. This peculiarity of special habitats for each species of tree is a distinctive feature of the forests of Western Australia, and one of the strong points in the disposal of its timbers.

The jarrah (*Eucalyptus marginata*) is without doubt the principal tree of the colony.

The botanical name of the tree refers to the thickened margin of the leaves; "jarrah" is the name given to it by the aborigines, and "mahogany gum" is that by which it is popularly known among the settlers.

There is nothing particularly picturesque about the appearance of a jarrah tree or a jarrah forest. The general effect *en masse* is dull, sombre, and uninteresting. Except in special spots and localities the tree is rugged and inclined to be straggling and branchy, unlike karri, which is almost invariably a fine straight tree, comparatively free from branches, except at the top.

In its general appearance the jarrah tree resembles very markedly the tree known in the other Australian colonies as stringybark. The bark is persistent, fibrous, and dark-grey in colour, but more deeply indented than stringybark. It is not uncommon to find considerable areas where many of the mature trees attain heights of 90ft. to 100ft. with good stems 3ft. to 5ft. in diameter, and the first branch 50ft. to 60ft. from the ground. Such areas are described as first-class jarrah forests; but on an average a jarrah tree of a good, healthy stamp is about 30ft. to 50ft. in height and 2½ft. to 3½ft. in diameter at the base. In fairly favourable situations trees of this size may be safely considered sound and convertible into good marketable timber. There are in places many individual trees the measurements of which are far in excess of those just mentioned. On the Ferguson River a tree has been measured of 22ft. in circumference at 5ft. from the ground, and 80ft. from the ground to the first branch. Such a tree should turn out at least 20 loads of good sawn timber. In good situations the jarrah attains a diameter of about 2ft., or reaches the stage when it may be considered fit for the sawmill when about forty or fifty years of age.

As regards locality, the jarrah, is, broadly speaking, confined to the south-western division of Western Australia. This division lies along the west coast between 31 and 35 degrees south latitude and 115 and 119 degrees east longitude, a stretch of country which extends nearly 360 miles north and south, and from 50 to 100 miles east and west, and comprises all that country on which the heaviest rains fall, averaging annually 40in. in the south and 35in. in the north. An average of ten years shows the mean annual rainfall of this division to be 38in.

The tree is not found much beyond the influence of the sea, and yet it is not at all partial to the direct effect of sea breezes. Perhaps the best jarrah forests are found 20 to 30 miles inland. It has not yet been ascertained whether this is simply due to the tree being found only in the heavy rainfall portion of the division, nor whether the growth would be as good further inland if there were the same rainfall there. Its principal habitat is along the tablelands and slopes of the Darling range of hills, which run through nearly the whole of the south-western division of the colony.

Next in importance to the jarrah is the karri (*Eucalyptus diversicolor*). This is the giant tree of Western Australia, if not of the whole Australian Continent. It is not so well known as jarrah, owing to the limited field of its growth and the (at present) comparative inaccessibility of its haunts.

The late Baron von Mueller gave the tree its botanical name, because of the paleness of the leaves on their lower side compared with eucalyptus generally; the poplar is the aboriginal name. In its youth it can hardly be beaten as an ornamental tree, being regular in its growth, straight and umbrageous; its leaves changing in a few years from an oval to those long broad shapes which mark its more mature condition. In this respect, and also in general appearance, it resembles much the sugar gum tree of South Australia (*E. corymocalyx*).

There is no doubt that karri is the finest and most graceful tree in the Australian forests. When matured, and of large dimensions, it is supremely grand, and in this respect at least it puts jarrah far into the shade. It is almost always straight in growth, and towers skywards for great heights without having even the semblance of a branch. A clump is like a mass of upright candles. The tree grows very rapidly, and soon attains great height and dimensions. A forest of marketable trees can be produced in thirty to forty years.

The bark is smooth and yellow-white in colour, but not persistent like jarrah. It peels off in flakes each year, and has always a clean bright look. In consequence of this it is frequently called white gum. The height is almost phenomenal. An average tree may be put down at 200ft. high, 4ft. in diameter 3ft. to 4ft. from the ground, and about 120ft. to 150ft. to the first branch. Trees of this size are generally sound in every respect, and may be expected to yield timber free from dry rot, gum veins, &c., to which large trees are usually subject. But much larger specimens are now and then found. On the Warren River it is not unusual to find trees 300ft. high, 20ft. to 30ft. in circumference at the base, and measuring more than 180ft. to the first branch.

The geographical confines of the tree are 115 and 118 degrees east longitude, and 34 and 35 degrees south latitude. Those confines comprise the more humid portions of the temperate region, where the annual rainfall is 35 to 40 inches. It is a coast region and very distinct in its general physical features from anything else in Western Australia. The tree seems a component part of its surroundings. Immense forests of trees, straight and of wonderful size, spring out of a rich, deep, spongy soil. The tree is sometimes found near the coast, but there it is scraggy, staghorned and branchy, and therefore not suitable for the saw mill, nor readily convertible into timber. Still it is essentially a coast tree, though shy of actual contact with saline particles, or of strong direct breezes. In this also it somewhat resembles jarrah, if not the eucalyptus family generally. The best karri

forests are at elevations of 300ft. to 600ft. above the sea. The wood is red and very like jarrah wood; indeed, it takes a good judge to distinguish the one from the other. Jarrah breaks clean, and if burnt gives a black ash; it is short grained and splits freely. Karri, on the other hand, will not easily split, and is apt to splinter; the ash of burnt karri is white. Karri wood is hard, heavy, elastic and tough, but does not dress, nor can it be wrought so easily as jarrah wood. For underground or water construction it is inferior to some other woods; still posts and slabs are known to have been in the ground for forty years with only an ordinary amount of decay. From tests which have been made in regard to its tensile, crushing, and breaking strength, karri is a wood of very high order indeed. It must, therefore, be regarded as one of the woods best suited for superstructures. It is also unequalled for bridge-planking, shafts, posts, felloes, and large planking of any sort, flooring, general wagon work and beams. In lateral strength it is very much stronger than jarrah, and for works required to bear considerable weights, such as bridges, floors, rafters, and beams of various kinds, it is of great value. It is much used in the Western Australian railway sheds for constructing wagons of all sorts. It shrinks laterally, but not to any great degree longitudinally. Altogether it is a most valuable wood. For street-blocking it is equal to, if not better, than jarrah, because traffic does not render it so slippery for horses' feet. It is largely exported for London street-paving, and finds a ready sale in South Africa, chiefly for purposes connected with mining.

The tuart (*Eucalyptus gomphocephala*) is a handsome eucalypt, very ornamental when young, and is planted as an ornamental tree in some of the Australian colonies. It is straight and well clothed, and has a beautiful bright green leaf, and is not unlike the karri tree. It is sometimes 150ft. high, and more than 22ft. in circumference at the base. Sometimes it rises 80ft. without a branch, but generally it has heavy tops with boles about 40ft. from the ground. It does not usually form dense forests, but prefers plenty of individual room. It is a pretty quick grower, and by cultivation attains a fair size in thirty to forty years. Its bark is of a greyish white colour and somewhat crinkled. Its habitat is the limestone belts round the coast between Perth and Busselton, a calcareous strip of country hardly ever more than three miles wide, but always quite close to the sea, and sometimes running into the coast sandhills. It seems gregarious, and does not intermingle with any other timber tree, except perhaps partly in places with a kind of stunted jarrah. The soil of the limestone belt is a sandy loam of considerable fertility, with a retentive subsoil. The tree thrives well on it. It is a coast tree, and its wood is the strongest, heaviest, and toughest in Western Australia. It is extraordinarily hard and so interlaced in the grain that it is difficult to split. It seasons without much shrinkage or splitting, resists changes of weather, and has some wonderful records. Its

timber is used for railway wagons, buffers, enginebearers, kelsons, standposts, bridge-supports, dock gate frames, wheelwrights' work generally, shafts, and most other works where great strength, solidity, and hardness are requisite. It is of a yellow-whitish colour, and so dense that it is difficult to work.

The wandoo (*Eucalyptus redunca*) is sometimes called the white gum. Wandoo is the aboriginal name. The habitat of the tree is very extensive. It may be said to be the principal forest tree on the eastern slope of the Darling Range. It is also found at intervals northwards to Geraldton and eastwards to the goldfields. It has a sort of yellow-white blotchy look, not clear white like karri, but more or less speckled, though smooth. It is well balanced and sturdy looking, and is always a clean, bright object in the landscape. It is not very large. Specimens 60ft. to 80ft. high, with diameters of 1ft. to 2½ft., are fairly representative of the species, although some are a little more than 100ft. high and 3ft. in diameter at the base.

The country on which wandoo is found growing abundantly and most luxuriantly is cold, hard, unpromising decomposed granite—a flat, stagnant soil, sandy on top, and invariably resting on pipe-clay. This makes a boggy country in winter and a hard one in summer, yet the tree seems to thrive well. In some cases the tree intermixes slightly with jarrah, and then the soil improves and has more loamy and friable particles.

Wandoo tracts form fine open forest country, but for the most part they are destitute of natural water. Good, plentiful water can be obtained by sinking to comparatively shallow depths. The timber is hard, very dense, somewhat dull or dark yellow in colour, durable, and remarkable for its lateral and compressive strength. It is frequently used for naves, cart and buggy shafts, spokes, felloes, and other rural purposes, and for railway truck construction, bufferstops, and other works requiring resistant strength. It is of great importance, and will eventually vie with, if not surpass, tuart. It is highly suitable for mining. It weighs 70lbs. per cubic foot, even after it has been seasoned for a considerable time. It is one of the principal trees on the goldfields, and there are several sawmills which cut it for general mining purposes. Were it not for wandoo the mines would be badly supplied with convenient stock. It was frequently used for general outside work in the early days of the Colony. Altogether it is a remarkable timber and very valuable.

The York gum (*Eucalyptus loxophleba*) is more or less scattered all over the wandoo country. The bark is rough, dark-coloured and persistent, and easily distinguishable from wandoo bark by its dark, rugged appearance. In other respects the two trees resemble each other in growth, habit, and general surroundings. The York gum rarely exceeds 100ft. in height and 3ft. in diameter at the base. Generally it is about 70ft. to 80ft. high and 18 inches in diameter. It appears to grow in any soil, but prefers

the richer and loamy deposits along depressions and watercourses. The wood is exceedingly dry, hard, heavy and tough, and is considered one of the best for constructing naves, hubs, felloes, and general wheelwright's work. It is in great request for such articles, and can hardly be surpassed. A large number are daily manufactured at Newcastle, and sent to various parts of the country. Inquiries for it are now being made by wheelwrights in Melbourne. It is said to be the very best timber in Australia for those purposes.

The yat gum (*Eucalyptus cornuta*) was first discovered at Cape Leuwin. Although not very abundant, it occupies a considerable place among the valuable trees of Western Australia. It is found all over the southern division, but only in small patches. It seems to prefer low-lying places, where the soil is deep and fairly moist. There are some good specimens met with about Lake Muir and in the country lying between that lake and Forest Hill. It is often found in the hollows of the wandoo country.

The bark is persistent, dark, rough, and rugged at bottom, but deciduous at the top. The leaves on falling leave the branches white, like karri. The tree is not very large; the extreme height being about 80ft., the diameter 3ft., to 4ft., and the stem 40ft. from the ground to the first branch. It is easily raised from seed, and is a hardy and a fast grower, adapting itself readily to situations with an annual rainfall of from 15 to 20 inches. The timber is excellent, and much used for shafts, spokes, naves, felloes, boat-ribs, and agricultural implements generally.

The sandalwood (*Santalum cygnorum*) is a peculiar tree in appearance, more like a large bush than a tree. It is of low depressed habit, branchy, and heavily topped. It is seldom more than 15 inches in diameter and 12ft. to 18ft. high, with stems about 8ft. to 10ft. long; but there are specimens more than 18 inches in diameter, with stems 12ft. long, and weighing 3 cwt. to 6 cwt. Trees have been cut each of which produced timber weighing more than half a ton. The tree is fairly distributed inland, except in the south-west. It grows most freely in barren sandy soil, and is frequently intermixed with wandoo, York gum and morrell. It is not gregarious. The first wood from the tree was delivered in Perth (the metropolis) by farmers in the eastern districts about fifty years ago, and was exchanged for goods. It was then shipped to Singapore and China. This trade continued with varying success till about 1882, when it virtually ceased owing to a decline in prices caused by the Chinese market being overstocked. Consequently merchants were encumbered with large quantities of stock. But now there is a revival, and all the old stocks along the Great Southern Railway are fast disappearing through the port of Albany, which seems destined to be the chief shipping place for the trade. There is also a considerable quantity exported from Fremantle.

Raspberry jam (*Acacia acuminata*) is a small tree about 30ft. high, with stems to 1 foot in diameter and boles 10ft. to 12ft. high. It is of a handsome rounded shape when allowed to spread out its branches, and the leaves are bright green. The popular name is derived from the peculiar scent of the wood, which is wonderfully like that of raspberries. An oil of the same flavour is obtained from the wood by distillation. The wood is very dense, and largely used for fences and survey posts. It seems to last for ever in the ground, and to be impervious to white-ants. It is a beautiful wood, dark in the middle, with a white margin on either side; and it is very heavy, and makes an excellent timber for cabinet and ornamental work of all kinds. Pipes and walking-sticks are sometimes made of it.

The red gum (*Eucalyptus calophylla*). Next to jarrah there is no tree so widely distributed as red gum. It is found intermixed with jarrah, wandoo, York gum and karri. It is the most numerous species in some places, but it cannot exactly be called gregarious. It is the only tree of any consequence between the Moore River and Busselton. It is common in the forests of the south-western division, which seems to be its only habitat. Although sometimes found growing luxuriantly on high ironstone ranges, it seems to delight most in deep red soils of flats and valleys, and in some places it is the principal, if not the only tree. It is seen to advantage about Perth. It grows as well in deep, sandy, porous soils as in those that are clayey and retentive. The botanical name refers to the beautiful appearance of the leaves; the popular has no special reference, unless to the gum which exudes from the tree, which is of a red colour, and gives the tree and the surrounding vegetation a reddish appearance. In karri country, where the soil is of a deep rich, loamy character, the tree is less subject to gum veins than elsewhere, and consequently the timber is more marketable. The hard, rough, and irregularly furrowed or broken appearance of the bark adds considerably to the rugged aspect of the tree. It is widely distributed, but its timber is classed as only of second-rate quality, because of gum veins which intersect it in every direction. Otherwise the wood is excellent. It is locally used in short lengths for axe and other handles, spokes, naves, rails, harrows, shafts and other farming implements. Although sometimes subject to attacks of white-ants, it is not apt to be destroyed by them.

The banksia trees and shrubs are an interesting feature in the flora of Western Australia, but they are more ornamental than useful. The river banksia is a fair-sized tree, and always found growing on rich alluvial flats or the banks of rivers. It is rather handsome and well grown, and has a very striking appearance when in flower with its yellow-red erect cones and light-green leaves. The wood is soft and light coloured, and used for making furniture and house fittings. It should make

good staves. It seems to become hard and durable with age. All the banksias are largely used for firewood.

The sheoak, or casuarina, is chiefly found in the south-western division. It yields a good timber for furniture, and is much used and well adapted for shingles, being durable and easy to split. It is fairly light in weight and beautifully grained. It is also very ornamental, and suitable for planting in parks and pleasure-grounds. It is very gregarious, and only found in clumps here and there in jarrah and karri forests. It is also found on dry knolls, poor soils, and rich bottom flats, and is always of greater size and beauty on the flats.—*Timber Trades Journal*.

The Extermination of Locusts.

IN view of the widespread devastation caused by locusts in many parts of the world, much attention has been given to devising methods for destroying them, and recently in South Africa the plan of spreading a disease among them has been tried. This disease is produced by infecting them with a certain fungus, concerning which some interesting particulars are furnished by the *Kew Bulletin* (Nos. 172—174, p. 94).

It has been known for a long time that many plants, mostly fungi, are parasitic on living animals, and in 1858 Professor Sebert suggested that the infection of noxious pests with a destructive fungus might prove useful for exterminating them. He was led to this view by observing that some healthy caterpillars placed in a tree along with some which were attacked by a fungus, very speedily contracted the disease, thereby showing that it was readily communicated from one to the other. During the last ten years extensive experiments have been carried out upon these lines, chiefly in France and the United States, with the object of exterminating the most common insect pests. In the former country the most destructive pest is the larva of the common cockchafer (*Melolontha vulgaris*), known as *le ver blanc*, and the fungus utilized for its destruction is *Isaria densa*, while in the States the "chinch bug" (*Blissus leucopterus*), which is very destructive to cereals, has been attacked by the use of the fungus (*Sporotrichum globuliferum*). The plan adopted is to prepare a pure culture of the particular fungus found by experiment to be most effective, and to distribute this in tubes, the contents of which, when mixed with a little water, being used to spray a portion of the infected ground or tree, or to inoculate a number of the captured pests, which are liberated when the disease has developed. It has been found, however, in these cases that the method, though theoretically perfect, does not always give good results, since the atmospheric conditions considerably affect the

spread of the infection. In dry weather the spores or conidia of the fungus do not germinate and contact-infection takes place but slowly, while during wet weather, on the other hand, the conidia perish through being washed into the ground, and as the larvæ or caterpillars do not move about, contact-infection is arrested. It is only during calm, damp weather that satisfactory results have been attained, and with reference to the American experiments, Professor Duggar, of the Cornell Agricultural Experiment Station, has stated that, although effecting a certain amount of good at times, the outcome is not sufficiently efficient to be of any practical value.

The attempt to exterminate the swarms of locusts in South Africa, more especially the red-winged locust (*Acridium purpuriferum*) by means of a fungus parasite, appears, however, to have met with much greater success. The fungus used was first observed by Mr. A. W. Cooper, of Richmond, Natal, who showed that it could be readily cultivated and distributed, while the disease produced was very contagious and fatal to the insects. As a result of his observations, pure cultures of the fungus were made on a large scale at the Cape of Good Hope Colonial Bacteriological Institute, and widely used with very satisfactory results. It was at first thought that the fungus belonged to the *Entomophthoræ*, but no definite identification had been made until recently when, on it being suggested that it might also prove of value in destroying fruit-tree caterpillars, specimens were forwarded to Kew. Its identification was rendered more necessary by the fact that Mr. D. McAlpine, Government Vegetable Pathologist of Victoria, announced in the interval that the Cape locust fungus was *Mucor racemosa*, and certain species of this genus are known to be destructive to fruit. Six samples of the fungus, two from Natal and four from Cape Colony, were forwarded for examination, and all these proved to be pure cultures of the same fungus, a hitherto undescribed species of *Mucor*. It has been named *Mucor exitiosus*, and a complete botanical description with figures is given in the paper. It grew readily on sterilised bread-paste, pineapple, or uninjured grapes, as well as on gelatin containing a decoction of plum-juice, in a solution of cane sugar, and in a sterilised decoction of decaying vegetable matter. The fungus can therefore live on very varied media, and, consequently, it is concluded that without further knowledge it would be unwise to spray its spores on fruit trees, as there is every likelihood of the fruit being attacked. It may be noted that the fungus was found to attack and kill cockroaches quite as quickly as it does locusts.

It has been suggested recently that the present Natal locust fungus is not the same as the species discovered by Cooper, but this suspicion does not appear to be justified, and has probably arisen through the distribution of some impure cultures. In one instance a culture was found to contain *Entomophthora grylli*, a fungus which has long been known as a parasite on various

species of crickets and locusts, but it is quite certain that it is not this, but the *Mucor* described above, which is the potent factor in the locust fungus prepared at the Cape — *Imperial Institute Journal*.

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[No. 3

The Food of Nestling Birds.*

THE amount of food consumed by nestling birds is not generally appreciated. The number of broods and of young vary according to the species and the region under consideration, but it is safe to say that on the average two or three broods of three to five each are raised every season. The young, from the time the eggs are hatched until the last offspring has left the nest, demand the most constant and untiring industry on the part of the parents. The labour of feeding begins before sunrise and continues with very little rest until after sunset. Meals are very frequent, often averaging one every two minutes. At first the nestlings consume more than their own weight of food in a day, and make a daily gain in weight of twenty to fifty per cent. At this time they appear to consist of little else than mouth and stomach, and spend nearly all their waking moments in eating. The total of the material required to satisfy their voracity is astonishingly large. A young robin kept in captivity required sixty earthworms a day, and the young of a pair of European jays were fed on half a million caterpillars in a single season. The character of the food consumed in such large quantities by different species of nestlings, apart from its scientific interest, is of great importance to the farmer and the forester, since many nests are placed in proximity to growing crops, nurseries, young plantations, &c., and the nesting season in the case of some of these corresponds with the period of greatest activity in growth of the vegetation.

Species of birds having a homogeneous diet, either animal or vegetable, rear their young upon food similar to that which they themselves take. Thus, gulls, terns, pelicans, herons, kingfishers, and the like piscivorous birds, bring up their broods principally upon fish; truly raptorial birds, such as hawks and owls, feed their young on birds and mammals; exclusively insectivorous birds, such as cuckoos, swallows, kingcrows, wagtails, babblers and warblers feed their young on nothing but insects;

* Adapted and abridged from a paper by Dr. Sylvester D. Judd in the United States Year Book of the Department of Agriculture, for 1900, by E. P. S.

and exclusively granivorous birds, such as doves and pigeons, feed them with only starchy seed-materials. But birds that subsist on both animal and vegetable matter usually feed their young almost entirely on insects, chiefly such injurious kinds as grasshoppers and cut-worms, and are therefore of great use to man. Many of our common Indian birds are comprised in this class.

Seed-eating birds and those that subsist on a mixed animal and vegetable diet, composed largely of hard material, have powerful muscular grinding gizzards, for food of this kind resists digestion and requires to be broken up in the stomach; but birds which live on insects or vertebrates that are soft and easily digested, have thin-walled, comparatively weak, non-muscular stomachs. These anatomical peculiarities, and consequent differences of function, must not be lost sight of in the study of the food of young birds, for they are responsible for marked differences of diet as maturity is approached. Whatever may be the character of the parents' stomach structure, however, the stomach of a newly-hatched nestling is in most cases merely a membranous sac with comparatively little muscular development, and cannot assimilate anything but the softest, most readily digestible material. Therefore, in the case of many species, the food of the young must differ radically from that of the adult. Such grain-eating birds as pigeons, possessed of strong gizzards, feed their young on the so-called "pigeons-milk," which is digested grain of semi-fluid consistency, disgorged by the parent bird into the gullet of its offspring. Many birds that are largely vegetarian, but not endowed with this power of regurgitating digested food, rear their young for a time on insects. The crow, whose annual food is three-fourths vegetable matter, will serve as an illustration. The first meal of the nestlings often consists of plump spiders of soft texture, which suit the delicate embryonic stomach; and these, together with tiny grasshoppers, nymphs and soft small cut-worms, continue for a while to form the food. As the stomach develops, however, the diet changes; such hard insects as beetles soon become a part of the fare, and by the time the young birds are nearly or quite half-grown, their stomachs are strong enough to digest corn. Corn is then given to them freely, and in increasing quantity, until, when they are ready to leave the nest, it forms about one-quarter of their food.

In the following study of the food of nestlings of a few of the various kinds of American birds, each group is taken up separately. The material was gathered from detailed field observations made by Dr. Sylvester Judd and others, and from the examination of the contents of the stomachs of 700 nestlings:—

ROBIN (*Turdinæ*).

It has been found that young nestlings of the robin (*Merula migratoria*) watched for several hours, were fed from five to six

times an hour. Subsequent examination of the stomachs of fourteen of these nestlings and of eight of their parents showed that raspberries, blackberries, cherries and serviceberries formed only 7 per cent. of the food of the young, while it formed 70 per cent. of that of the old birds. In the case of the young many of the stomachs contained pellets of grass, one in each stomach, the significance of which is not clear. The insect food of the young consisted chiefly of caterpillars, locusts, grasshoppers, crickets and beetles (carabid beetles, May-beetles, and their larvæ). Spiders, snails and earthworms were present in smaller quantities.

HOUSE WREN (*Troglodytes aëdon*).

The house wren (*Troglodytes aëdon*) is exclusively insectivorous, and is one of the most useful birds on the farm. Half a day's observations showed Dr. Judd that the young are fed very frequently, and consume an enormous quantity of food. A brood of three about three-fourths grown, were observed. The following are the details:—The mother wren made 110 visits to her little ones in four hours and thirty-seven minutes, and fed them 111 insects and spiders. Among these were identified 1 white grub, 1 soldier bug, 3 Noctuidæ, 9 spiders, 9 grasshoppers, 15 May-flies, and 34 caterpillars. On the following day similar observations were made from 9-35 A.M. till 12-40 P.M., and in the three hours and five minutes the young were fed 67 times. Spiders were identified in four instances, grasshoppers in five, May-flies in 17, and caterpillars in 20. The usual difference between the food of adult birds and that of their young ones is less marked in the case of the house wren.

WARBLERS (*Sylviniæ*).

Warblers are insectivorous, and probably rear their young on a purely animal diet. Little definite observation is available, however. The stomach of a warbler examined contained beetles of the family *Lampyridæ*, and click beetles (*Elateridæ*), caterpillars, moths, spiders, and snails. Another observer states that a nest of redstarts were fed on insects from five to twenty times an hour, the insects being caught on the wing by the mother bird, and often included Noctuidæ.

SHRIKE (*Lamiidæ*).

One of these birds was observed carrying mice and warblers to young nestlings, and a deserted nest was found literally lined with the wing-covers of the useful predaceous tiger-beetles (*Cicindelidæ*). Six nestlings and six adults of the above alluded to species of Shrike examined had eaten grasshoppers to the extent of 75 per cent. of their food. Both old and young birds had taken some beetles, crickets, and spiders. Two of the young had eaten parts of mice, but the adults had fed solely on insects.

SWALLOWS (*Hirundinidae*).

Swallows are exclusively insectivorous during the breeding season, and rear their young on insects. The parent birds of a species of martin were found to have carried to their nestlings dragonflies, butterflies, moths, grasshoppers, beetles and flies. They made from 100 to 300 visits a day to each nest. Another observer states that a quart of wing-covers of the cucumber beetle (*Diabrotica vittata*) have been taken from the nesting box of a martin. The food of the young does not differ materially from that of the adults. Swallows do good service by destroying injurious flies, weevils, bark beetles (*Scolytidae*) and harmful species of ants.

SPARROWS (*Fringillidae*).

Native American sparrows are granivorous to the extent of two-thirds or more of their diet, but apparently rear their young exclusively on insects. In the stomachs of ten nestlings and fourteen adults examined half of the food of the old birds was found to be grass-seed, while that of the young consisted entirely of insects, caterpillars, grasshoppers, and a very few spiders. Dr. Weed watched the feeding of a brood of three nearly fledged nestlings of the sparrow (*Spizella socialis*) from 3-40 A.M. to 7-30 P.M., when darkness put a stop to further work. The first meal was served to the youngsters at 3-57 in the morning and the last at 7-27 in the evening. Throughout the long day the parent birds kept flying to and from the nest, bringing food and carrying away excrement. The largest number of visits in a single hour was 21, and the total number of visits for the day amounted to nearly 200. The longest rest was one of twenty-seven minutes in the afternoon. Although but few of the smaller objects fed to the nestlings could be identified, the larger forms of insect food were satisfactorily determined. Most of these appeared to be caterpillars, but some few were crickets, crane-flies, and earthworms. No less than 50 caterpillars, mostly noctuids, were brought to the young during the day. Thus making the moderate assumption that there are 20 broods of these sparrows on a farm of average size, and that each requires as many caterpillars as this one observed by Dr. Weed, the number of these pests consumed amounts to a thousand a day.

The adult English sparrow (*Passer domesticus*) is almost exclusively vegetarian in diet. It derives less than one-tenth of its food from the animal kingdom. Its nestlings are, however, insectivorous to the extent of more than half of their diet, while grain, principally oats, forms only one-third of their food. The insect food of 65 nestlings, most of them not feathered, consisted principally of grasshoppers, together with a few caterpillars, spiders and weevils. These sparrows were one morning observed feeding on white-ants which were swarming over a sidewalk near the building of the Department of Agriculture at Washington,

D. C. All the birds were frightened off, except one female, which continued to snap up ants undisturbedly. She flew with a dozen up to her nest in the gutter of a house, and immediately returned. At the end of five minutes she had made three more trips, carrying to the young 41, 71, and 50 in the respective trips; 162 white-ants were thus disposed of in five minutes.

The feeding habits of young English sparrows of cities are of value, since many of the insects eaten are injurious, while the vegetable food, being composed of waste oats in horse droppings, is of no importance; but in the country the good effect caused by the destruction of insect pests is largely counterbalanced by the fact that much of the vegetable food consists of grain derived from crops.

ORIOLES (*Criolidæ*).

Orioles are insectivorous birds, and though at times troublesome to the horticulturist, they are often most beneficial. Of three nestlings and their parents examined mulberries formed a quarter of the food of the old birds, but the young proved to be exclusively insectivorous. They had been fed on May-flies, spiders, caterpillars, and grasshoppers.

BLACKBIRDS (*Turdinæ*).

Ninety-nine per cent. of the food of young ones has been shown to be insects, whereas one per cent. only consisted of weed-seeds. Weevils and leaf-beetles were noticed amongst the chief insects eaten, grasshoppers, contrary to the general rule amongst young birds, being much fewer. The food of the adult is one-third to half animal matter, the remainder being vegetable. 165 nestling birds were collected and examined. They were divided into three groups: the newly-hatched, the half-grown, and the nearly fledged. The first group proved to be exclusively insectivorous, and the third decidedly granivorous, 25 per cent. of the food being corn. The middle group was naturally intermediate in diet between the other two. The service performed by the young of these birds in destroying insect pests far outweighs the loss due to the consumption of corn by the old birds.

CROWS (*Corvidæ*).

The adult American crow (*Corvus americanus*) is vegetarian to the extent of two-thirds of its diet, and half the vegetable food consists of grain, principally corn. But nestling crows consume large quantities of cut-worms, grasshoppers, and May-beetles, both larval and adult, thus rendering considerably more service to agriculture than the adults. In fact the quantity of insect pests they consume exceeds in volume more than two to one the corn they take. From some three week old nestlings examined it was found that at this stage about three-fourths of their diet consists of equal quantities of beetles and the flesh of vertebrates, such as

fish, frogs, salamanders, turtles, snakes, birds, mice and rabbits. The adult birds feed largely on seeds when they can obtain them, and in American coniferous forests stomachs of old birds examined showed that they fed almost exclusively on the seeds of these trees. It must be borne in mind, however, that the damage thus done by the parents is far outweighed by the good done by the youngsters in keeping down insectivorous pests, and consequently the old birds should on no account be trapped or shot through ignorance by forest employes. In our Indian nurseries birds of all kinds can with a little care and trouble be kept off the beds sown with seed until the young seedlings come up, and when this event has taken place it will be found that those very birds who previously would have done damage by feeding on the seed in the beds are now doing good by removing from the neighbourhood of the seedlings noxious cut-worms, caterpillars and insects of all kinds.

FLY-CATCHERS (*Tyrannidae*).

The American king bird (*Tyrannus tyrannus*) is said to be one of the most beneficial birds of the farm. It destroys beetles and flies injurious to the stock, and other insect pests not usually molested by birds; and while it also kills honey-bees, it almost invariably selects the worthless drone.

This fly-catcher saves grain, game, and poultry by driving away the crows and several species of hawks—notorious marauders of the farm. Grasshoppers form a large item in the food of the nestlings.

WOODPECKERS (*Picidae*).

Woodpeckers live on insects and berries. The stomachs of three nestlings and their two parents examined contained ants, spiders and beetles. The young had eaten more spiders and fewer beetles than the adults, but the principal food in all was ants. It has been also observed that the young are sometimes fed on sap to a certain extent, and it is considered that whilst ants compose about a third of the food of some adult birds, sap and alburnum, or the tissue between the hardwood and the bark of trees, are also largely taken, in securing which the birds often kill the American gray and white birches, and are at time injurious to apple and other trees. In view of these observations it will be worth considering whether the silver fir trees in the Jaunsar forests of the North-Western Himalayas, which are often pitted for some distance up with concentric rings of holes bored by woodpeckers, are not attacked by the birds with this object. The search for both insects and sap and cambium may be the bird's object in thus boring into these trees.

KINGFISHERS (*Alcedinidae*).

Kingfishers are piscivorous, but not entirely so, for they occasionally eat frogs and mice. Fish forms the principal food of the young, though beetles of three kinds—ground beetles, water, and dung beetles, are also eaten.

CUCKOOS (*Cuculidæ*).

Cuckoos are exclusively insectivorous. They probably do more to protect foliage than any other birds, and should be rigorously protected by the horticulturist, for they subsist largely on hairy caterpillars and other larvæ, which defoliate the orchard, and are at times a source of considerable annoyance and expense to man. An example occurred this year in the station of Seoni, in the Central Provinces. The houses and compounds of the Europeans, and the bazars and roads, drains, &c., were invaded by a host of hairy caterpillars in September, which practically took possession of the place, hundreds of maunds being killed and removed daily. On account of the urticating properties of the hairs of these processional caterpillars few birds will touch them. Cuckoos however devour these hairy caterpillars in such quantities that their stomachs often become lined with a coat of fur. They also eat beetles and toads and are destructive to snakes.

HAWKS (*Falconidæ*) and OWLS (*Strigidæ*).

No birds have been subject to so relentless a persecution as the hawks and owls. Throughout the length and breadth of England few gamekeepers or farmers would be found, a few years ago, to say a word in favour of either of these birds, which they classed with vermin, to be shot on sight, or trapped when possible. Latterly this gross ignorance of a very conservative race of men has been here and there enlightened, but an examination of the backs of many a barn or the nail of an adjacent paling (the show-place and tit-bit invariably kept to the last when showing a visitor round), scattered all over the country, will show the remains of many an inoffensive species of owl and hawk. Whilst one or two species of both these birds are injurious, feeding upon game-birds and other useful birds and poultry, the greater number of both are quite harmless, their food consisting of insects and young destructive rodents, such as mice and rats, which they destroy in enormous quantities, together with frogs, moles, and snakes; they thus act in a most beneficial manner on the farms, &c. The barn-owls are most valuable on a farm, as they tend to largely keep down the increase of mice and rats—those pests of the grain stores.

VULTURES (*Vulturidæ*).

Vultures are flesh-eaters, and, as scavenger-birds, are most useful in India in removing dead carcases. The marvellous way they assemble to such a feast is well known.

PIGEONS (*Columbidæ*).

Pigeons and doves are almost exclusively grain and seed eaters, both in the nestling and adult state.

GALLINACEOUS BIRDS (*Gallinæ*).

Include such birds as the pheasant, jungle fowl, partridges, quail, grouse, &c. These birds are not wholly vegetarian in diet as

is popularly supposed, but are mixed feeders, and probably feed their newly-hatched chicks principally on insects, destroying such dreaded pests as cut-worms, beetles, bugs, locusts, &c. Quail are noted as destroying the Rocky Mountain locust in America. It is not impossible that they attack and destroy large numbers of the migratory locusts (*Acridium peregrinum*) in India, and if this be the case in years when invasions of these insects are experienced, sportsmen would be well advised if they left these birds alone for that season. There is no doubt that gallinaceous birds of all kinds are extremely useful to the farmer, and the damage done in the grain-fields by the adult birds in India must be far outweighed by the enormous number of injurious insects destroyed in feeding the youngsters.

As is well known, on shooting estates in England, &c., large sums are spent yearly in rearing young pheasants and partridges on grain. That in the case of partridges, at any rate, this is unnatural and unnecessary has been more or less proved. An interesting correspondence on the subject has been recently conducted in the periodical *Country Life*. I extract the following notes by Mr. A. T. Williams from the October number of last year (1901):—"The correspondence about the food of partridges is most interesting to all lovers of shooting, and I am quite sure that corn is no more necessary to the partridge than sweets to the schoolboy. Grain, doubtless, is an attractive luxury, but it certainly is not an indispensable food. A striking example of this occurred this year. For many years I have always shot in Norfolk, with its large stubbles and abundant rootfields, but an opportunity arising to rent a shooting within a short drive of my own door, I found myself, in January last, a tenant of 160 acres of wood surrounded by poor grass meadows, which had, however, good nestling hedgerows. Not a grain of corn and not a swede of turnip had been grown on the farm for years. I found a fair stock of partridges, and though the time was too short to exterminate the vermin thoroughly, I have been quite surprised at the large number of partridges the land has produced. In the hatching season there was no insect food, owing to the prolonged drought. The ant-hills were like iron, and often, going on one's hands and knees, instead of the grass teeming with insect life not a creeping thing could be seen. Hand reared pheasants did badly, but the partridges and wild pheasants led their broods to the soft places in the woods, and found thus the insect-life which the cooped birds could not reach. Those who have shot with me have been amazed at the stock of partridges which have no grain food of any kind."

SHORE BIRDS (*Charadriidae*).

The data concerning the food of young shore birds are somewhat limited. Young woodcock can be reared on earthworms, caterpillars, &c., whilst the old birds feed almost entirely on

earthworms, with a few beetles. Sandpipers feed on wasps and carabid beetles, and also water beetles.

CRANES (*Gruidæ*).

A chick of *Grus mexicana*, an American species, thrives on a diet of earthworms and carabid beetles. It also feeds largely on cicadas, often eating a quart a day.

WATER BIRDS (*Gaviæ, Anseres, Herodiones, &c.*).

The food of nestlings appears to be similar to that of their parents, *i.e.*, principally fish. Gulls, terns, &c., are exclusively piscivorous. Young ducks feed on insects, picking from the surface of pools May-flies, locusts and grasshoppers and other insects. It is probable they feed also on frogs and tadpoles, mollusks, crustaceans, and small fish.

Some species of herons feed almost exclusively on fish, rearing their young on them, and so are injurious to pisciculture; but others are useful, as they feed on injurious insects and mice.

CONCLUSION.

From the above it will be observed that whatever the character of the food of the adult birds, the young, excepting those of the doves and pigeons, are at first fed on an animal diet, and that this diet is gradually changed, when change is necessary, to conform to that of the mature bird. This is probably due to the fact that animal food has a high nutritive value, and is more easily digested than the available vegetable food. Spiders, grasshoppers, caterpillars, &c., answer these requirements very well, and form a favourite nestling food with many species of passerine or perching birds. Birds that are largely vegetarian mix increasing quantities of fruit and grain with the insect food, though insects usually remain the chief component of the food until maturity is reached; the harder insects, such as beetles, being gradually substituted for the softer ones.

I will add one more example of the powerful influence insectivorous birds have on the removal of pests. During the outbreak of the Rocky Mountain locusts in Nebraska, in 1874-77, Prof. S. Anghey saw a long-billed marsh wren carrying thirty locusts to her young in an hour. At this rate, for seven hours a day, a brood would consume 210 locusts per day, and the passerine birds of the eastern half of Nebraska, allowing only twenty broods to the square mile, would destroy daily 162,771,000 of the pests. The average locust weighs 15 grains, and is capable of each day consuming its own weight of standing foreign crops, corn and wheat. The locusts eaten by the nestlings would therefore be able to destroy in one day 174,397 tons of crops, which at \$10 per ton would be worth \$1,743,970. This case may serve as an illustration of the vast good that is done every year by the destruction of insect pests fed to nestling birds. And it should be

remembered that the nesting season is also that when the destruction of injurious insects is most needed, *i.e.*, at the period of greatest agricultural activity and before the parasitic insects can be depended upon to reduce the numbers of the insect pests. The encouragement of birds on farms, in nurseries, &c., is therefore more than a matter of sentiment; the birds will return a hard cash equivalent and have a definite bearing on the success or failure of crops, on the success or failure of the nurseryman, &c.

Attention cannot be too strongly directed to this point in India. The question of the protection of birds is receiving the attention of Government, and it should be borne in mind that the question is one affecting the public good as a whole, and not merely one in which a few scientists or lovers of the beautiful are concerned in the preservation of some species from extinction or for merely æsthetic reasons, good as such reasons may be. The case is one rendering the severest legislation enacted in the protection of birds from the murderous onslaughts of ignorant men justifiable, and not only justifiable but imperative. The ignorant destroyer of useful birds is in the same category with the thief taking money out of his neighbour's pocket, and should be treated as such.

As regards the encouragement of birds in India, much good may be done by the formation of hedgerows and thickets in extensive tracts of land under cultivation, such as the wide areas under cotton, rice, &c., and in the neighbourhood of nurseries, young plantations, &c., and also by providing simple nesting places. Such can be conveniently made by setting lengths of the large-girthed hollow bamboos upright in the ground, holes having been cut in them on one side just above the nodes, or by fixing small boxes to upright poles. Without some such provision birds requiring such positions to nest in will not stay in an area, and any means by which insectivorous birds—and I have shown that most are such in their younger stages—can be encouraged, will more than repay the small outlay required by the increase in the cultivator's feathered friends and a decrease in his insect pests.

E. P. STEBBING.

Forests and Water-Supply.*

(An instance from history).

EVERYBODY has heard of the monks of La Trappe, or Trappists, an order whose vows include a life of silence coupled with 8 hours' hard work daily. The monastery was founded in 1140 by Rotrou II., Count of Perche, after losing his wife and his brother William in the wreck of "La Blanche nef." The forests with which it was endowed were kept till the Revolution, when

* "La Forêt de la Trappe," *Revue de Eaux et Forêts* for November 1901.

they were confiscated to the State. Under which of the "rights of man" this course was justified it boots not to enquire.

Whether the Trappists had been abusing their forests is not distinctly explained, but it appears that they had certainly been cutting the coppice portion (the greater part) too young, for at the Reformation of 1665 an edict went out against them. This no doubt emanated from the great Colbert, and ran thus:—"The religious community, the abbot, prior and convent of Notre Dame de la Trappe, &c., are hereby forbidden to cut any of the woods attached to the said abbey before the age of fifteen years, seeing the poverty of the soil. They shall regulate their coupes into fifteen equal fellings, and they shall leave standing at each felling the number of standards required by law; they shall allow one-third of their forest area to grow as high forest on the best soil in proximity to the Abbey itself."

This was duly observed till 1700, when the Abbé de Rancé died after ruling the monastery wisely and well for thirty-seven years. After his death the Trappists thought they would launch out into great ironworks, and the forest had to pay for the disastrous experiment. An old book "*The Life of Dom Pierre the Dwarf, cleric and former sub-prior of the Abbey of la Trappe,*" 1715, states the matter with due appreciation:—"Iron ores have ever been plenty about the Abbey of la Trappe, and many times had the holy father the late Abbé been supplicated that he would allow it to be dug out by private persons who desired to establish ironworks. The abbey might expect much profit and no expence. Never would Dom Bouthillier de Rancé yield, for he foresaw beneath the promise of large profits the certain ruin of the revenues of his house, coupled with spiritual demoralisation and the relaxation of all the orderly life which he had been at so much pains to institute.

"But hardly was this holy man laid to his rest than Dom Jacques de la Cour, the new Abbé, lent a willing ear to the proposals of certain monks whose vows of solitude, &c., weighed too heavy on their impetuous natures. He took up a contract to run the ironworks of la Trappe for thirteen years, and agreed to pay 2,800 livres for every year. Then destruction ran loose in the forests. Nobody knows how wastefully the furnaces swallowed up wood that might have been simply sold to a far better effect. *The springs soon dried up and the ponde (they had always depended on a series of ponds for water-power) became unable to supply more than six weeks water for the year.* The fires had to go out. The cost of re-lighting them at intervals was prohibitive. Thus fell to the ground all the ambitious hopes of the new Abbé. La Trappe became desperately indebted, much of its property had to be sold, and the monks were often in absolute want of the necessaries of life." Dom Jacques de la Cour became naturally Dom Jacques de la Sacque, and the ironworks, the monastery, and the forest were involved in a common ruin. So far as the forests

are concerned, the State is now working them under a plan of 1894, in three series; a high forest under a sixty years' provisional plan, and 2 coppices with standards.

Such is a story that was printed two hundred years ago, long before forest officers, and their opponents, began to seek for proofs of one or another disputed matter."

F. G.

II. CORRESPONDENCE

VI.—EXTRACTS, NOTES AND QUERIES.

Stem of *Dalbergia paniculata*.

T. G. HILL describes in the "Journal of Botany," xv., 1901, the peculiar structure of the stem of this Indian tree. The peculiarity consists in the presence of broad concentric masses of xylem alternating with narrow, soft layers of a fibrous substance. The narrow zones are of the nature of phloem, accompanied by a certain amount of cambium. The phloem contains well-marked sieve-tubes with sieve-plates. The xylem masses present no special character. The peculiarity of structure is attributed to the formation of successive cambium rings.—*Journ. R. Micro. Soc.*

Pneumatophores.

Sonneratia indica and other plants possess a kind of breathing-pores, the structure of which is described by M. Westermaier (*Botan. Centralblatt* lxxxvi., 1901, p. 392). That they are not true roots, but organs *sui generis*, is shown by the cork mantle, the absence of a true root-cap, and the order and place of appearance of the primordial vessels.—*Journ. R. Micro. Soc.*

New Reaction for Woody Tissue. *

C. MAULE has found that woody tissue, treated with permanganate of potash, followed by hydrochloric acid and ammonia, turns red. One grm. of permanganate is dissolved in 100 c. cm. water, and the sections are immersed for 5 minutes. They are then decolourised in HCl for 2 or 3 minutes. After the addition of ammonia, or holding them over a bottle containing ammonia, they turn red. The reaction may be hastened by heating the permanganate on the slide, and instead of ammonia caustic potash or soda may be used. The time the permanganate takes to act varies with different plants, the coniferæ being specially resistant.

Structure of Coppice Shoots and Suckers. *

M. DUBARD has examined the anatomical structure of the shoots which appear on the trunks of most trees and shrubs when in full vigour and after the cutting down of the stem—from the root in *Populus*, *Ulmus*, *Corylus*, *Lycium*, &c.; from dormant buds in *Quercus*; from the cambium zone in *Quercus*, *Populus nigra*, &c. These shoots present many of the characters of herbaceous plants in their rapid growth, elongated internodes, well developed and persistent stipules, scattered buds, smaller differentiation of the tissues, especially of those connected with protection or support, in the smaller production of phloem in comparison with xylem, in a smaller development of assimilating tissue, and in the much smaller excretion of calcium oxalate.

The Identification of Wood.

BY HERBERT STONE.

THE subject upon which I have the honour of addressing you to-night is incomplete, and, as yet, quite in its infancy. As a scientific study it is by no means new, but the technical application of it may be said to be comparatively recent, as might be expected, because a certain amount of progress must be made and sufficient methodically-arranged information must be accumulated before the commercial man can employ it usefully. In short, until science has something substantial to offer, which will stand the commercial test, it is far better to continue the use of the old rule-of-thumb methods, which, after all, have sufficed to make the world go round till now. Whether the art of discriminating the various species of timber has arrived at that desirable stage, I must leave it to your judgment to decide, but I feel that a ventilation of the subject must be productive of good, and hope that it will arouse sufficient interest to bring recruits to

* *Comptes Rendus*, cxxiii. (1901), pp. 1356—8 and *Journal of the Royal Microscopical Society*.

this inquiry. It is a field in which the greater part of the ground is unbroken, and when nearly all other subjects have been thoroughly worked, it is something especially gratifying to an investigator to find himself in the midst of a practically unexplored area. The nearest comparison I can think of would be the case of a man set to classify the specimens of a herbarium from which all the flowers had been removed. The material would be sufficient for the purpose, the schemes of classification would be at his disposal, but he would be compelled to invent for himself the means of discovering the relationship of his plants one to another. I may say that there is nothing extravagant about this simile, for Radlkofer and the botanists of his school, chiefly Dr. Hans Solereder, have worked out a system by which small and imperfect specimens of plants may be recognised and classified, and in some respects have made discoveries which materially aid us in the discrimination of timber. Unfortunately for us, this school of Radlkofer has confined itself to the examination of such small twigs and woody stems as are usually found along with herbarium specimens, and as the secondary wood, or that produced after the first year, frequently differs from the primary wood, which is their special care, their labours are only useful by the way, and in rare cases.

The chief contributions to the branch of botany have been made by students of forestry, and as forestry is little known and appreciated in England, it is to Germany that we must look for information. The two Hartigs and Franz Schwartz have dealt with the European trees in a fairly complete manner, and Mayr has made some important contributions to the anatomical characters of the conifers of North America, but foremost stands Nördlinger, who has described the structure of no less than 1,100 species of timber trees, and whose series of sections is the wonder and admiration of the few who have seen them.

J. S. Gamble's "Indian Timbers" is a fine work, and the only one which is published in the English language (saving a translation of a small *brochure* by Theo. Hartig). His collaborator, Sir Dietrich Brandis, who did the descriptive work for "Indian Timbers," is perhaps the chief living authority on the subject. A magnificent series of 200 sections of American woods, published by Romeyn B. Hough in the United States of America, is another substantial aid; but unfortunately his descriptions accompanying the sections show that the author is unaware of the significance and value of his own specimens.

In all these books there is nothing approaching a scheme of classification. The nearest is contained in the notes accompanying the descriptions in J. S. Gamble's "Indian Timbers," but as they are based exclusively on the local species, they are quite useless when applied to timbers of other countries. All other authors confine themselves to isolated descriptions of species, with an artificial key as a guide amongst chaos.

We can now see what our future labour is, and I must content myself with indicating it, merely repeating that the harvest is ready for any one who will lend his assistance.

In the meantime there is no necessity to underrate the value of the old time-honoured rule-of-thumb method, and we shall do well to hold to everything that is good in it, and to add such precise knowledge as can be accumulated. Heretofore, everything was left to individual judgment, which implies great experience, needing time and opportunity to acquire. Learners had no easy task before them and no aid except that of teachers; still it sufficed until foreign timbers began to be imported in increasing variety, which, in proportion, restricted the possession of expert knowledge to the few. The carpenter knows the woods he works with from continually handling them, and can, perhaps, distinguish a dozen or twenty of them with ease. Beyond these he is at sea. The timber merchant dealing in hardwoods has a longer list of familiar woods, and having spent his days amongst them he becomes an authority upon them. But the process of handing a strange piece of wood round until someone is found who knows it, is a part of the daily routine even at the oldest houses. When, as often happens, a species not previously met with turns up, even the most expert are helpless, and I think they will be the first to admit that some means which will eke out their experience is desirable. I have met with cases where a wood well known and largely imported has been pronounced by various timber merchants to be something quite different, and others in which inferior woods have been palmed off upon purchasers when their superficial resemblance to the superior article has been close enough to deceive. I have also known a case where an inferior wood, selling at a low price, has obtained a much higher one by the simple expedient of changing the name to B when it has been previously known as A. Without dwelling on these doubtful practices, which are exceptional, more than to lay stress on the fact that the lack of information makes them possible, I will turn to another class of cases, those in which a consumer desires to match an unknown wood, or having tried a parcel with success, is unable to obtain a second for the reason that he does not know for what to ask.

Many hundreds of consignments of excellent timber reach our shores, and failing sufficient information as to their name, origin and virtues, are passed by purchasers until they are finally relegated to a rummage sale, where all "unrated" timber is put up to auction for the purpose of recovering the freight and dock dues. Amongst these "unrated" woods have been many which have excited admiration for their beauty or other excellence, and in some cases have changed hands after the discovery of their value at fancy prices. But when the parcel is sold out, the trade in these woods is closed, for the unfortunate sender of them is careful not to risk another loss on the same timber; thus no more comes forward, and as the consumer has no means of finding out the

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name and place of origin of the coveted wood, he has no opportunity of making his wants known to the person who could satisfy them. From what I have seen myself, I feel certain that there are many species of timber trees growing, maybe in abundance, in many localities from which shipment might be made, that are ignored, because they bear a reputation of being unremunerative, and are probably put locally to base uses.

If you will look through any old list of hardwoods you will see the names of many that were familiar years ago, but which are not now met with. Did the consumption of the timber trade of the last generation exterminate these trees? I cannot believe it, for even if a small locality were entirely stripped of a species, there are few that are confined to such small areas. Possibly if they grow elsewhere we may by some good chance hear of our old friends again when other forests are opened up, and I hope that with the increasing means of identification which the anatomical characters afford, we may not only discover the species, but also indicate in what other regions a fresh supply of our lost timbers may be found.

I was recently amused by receiving a circular from a hardwood merchant, containing a long list of uncommon woods. I wrote asking for specimens, and was informed that though anxious to oblige, the merchant could not send them, as most of the woods enumerated had not been met with for years. The old list had evidently been reprinted from time to time, in the hope of supplies turning up.

There are instances already on record where the anatomical characters have been commercially useful, and unknown woods identified by their means have lead to inquiries in a proper direction being made for fresh supplies, but this can only be done when the structure is put upon record in such a fashion as to be traceable when needed, a state of things which does not yet exist. The cases in point were the result of a happy recollection of the special *structure, and not of method*. It is also necessary that the scientific name should accompany the description of the structure. If the popular or vernacular names only are known, we really are not much further ahead, because there is usually a name in every locality and sometimes several.

To base this art upon a secure foundation, it is absolutely necessary to obtain authenticated specimens. One may describe the structure of the African oak, and it may be an advantage to identify other specimens of African oak from the description, but it will be useless for a purchaser to inquire for it under that name in localities where it is called African teak. If we only knew the specific name we could point out fresh localities where any botanical explorer may have recorded its occurrence.

By the way, botanical explorers have a vexing way of omitting anything likely to be useful from their descriptions of plants. They describe the flower, leaves, and habit with great precision;

and I have known, as a rare case, a botanist to mention that a plant produces the fibre, gum, drug, or what not of commerce; but he gives no indication whatever of the special features by which the fibre, gum, or drug may be recognised. This is lost opportunity, for the information must have been in many cases within reach, and would have been precious; but as it is, we must begin again at the beginning, make our own explorations, and in fact conduct a duplicate survey over precisely the same ground, with a but slightly different object. With this view I have appealed to the Colonial Office for authenticated specimens of all colonial timbers, with a view of putting their structure on record, and enabling not only our home traders to recognise unfamiliar colonial timbers when they meet with them here, and to satisfy their wants by purchases from our brethren of Greater Britain, to the benefit of each other, but also to enable our colonists to recognise their own woods for their own uses. If experts are scarce in England, they must be far rarer in new countries. Besides this, our settlers had a limited knowledge of English trees when they left our shores, consisting of a few names, such as oak, beech, ash, elm, pine, &c., and every tree they met with in their new home became native oak, native beech, &c., with the variation of a few simple adjectives, such as red ash or black ash. When these become exhausted, the alternatives are red wood, white wood, yellow wood, iron wood, and the like, hence we must not be astonished to find that in different parts of Australia no less than five distinct species of eucalyptus pass under the name of Red Gum, and two or more under that of Blue Gum.

I am fortunate in being able to make my appeal at a time when the office of Colonial Secretary is filled by a man whose foresight and acumen are as keen as his care for the interests of the colonies is enthusiastic. In short, by his kind recommendation of my petition to the various Colonial Governments, I have already obtained promises of authenticated specimens of the woods of Canada, the Cape of Good Hope, Victoria, Queensland, Western Australia, Lagos and Rhodesia, and, with one or two exceptions I have very little doubt that a similar response will be received from those Governments which have not yet replied. In my petition I have asked for a specimen of each wood sufficiently large to provide duplicates for several public institutions.

However complete the knowledge of the colonial timbers may become in the course of the next few years, it will be a mere fraction compared with the work that will remain, and which will be left to travellers who may be persuaded to take note of the timbers as well as the flowers they meet with. Perhaps if the scientific side of our study can be developed sufficiently to attract the attention of botanical explorers, we may achieve our end by their assistance.

So far the work of Solereder and others has aroused very little enthusiasm, and it has been stated that the value of the

anatomical characters for the purpose of classification is trifling. With this I am inclined to agree in part, because so much stress has been laid upon the sculpture of the walls of the individual cells, failing more prominent characters. It is, no doubt, a valuable contribution to our knowledge to know that certain forms of pits are constant in a natural order, but if, as usually happens, they are equally constant in a score of little related orders, they afford little help in separating one from another. The primary wood dealt with by the school of Radlkofer is not enough by itself; the material is too sparing and it holds the same position in lignology as animal embryology does to anatomy. It is the study of an immature condition only. Besides this their descriptions are lacking in vividness.

As a matter of fact, the diagnosis of the characters of wood depends very greatly upon precision of language, and this again upon a knowledge of the infinite variety of form which may be presented by the pores, rays, and soft tissue. It must be clearly understood that the width of the annual rings, the most conspicuous feature, is rarely of any value, and I shall be glad if, when looking at the specimens I am about to show you, that you will endeavour to ignore this factor altogether. A ring of oak wood may be $\frac{1}{16}$ th of an inch wide, or may reach $\frac{1}{8}$ ths, and the difference in the appearance of a piece of wood containing 16 rings per inch of radius, and another only showing 2 is exceedingly difficult to reconcile. *This variation is merely a question of growth, and depends upon the fertility of the soil, &c., so that the extremes may frequently be present in the same piece of wood in the closest proximity.* This much may be said, that the annual ring usually makes a good start in the spring, when the tree puts forth its leaves, so that the innermost layer is usually normal, but should the supply of nourishment fail from any cause, such as the destruction of the foliage by frost or caterpillars, the later wood of summer and autumn may be reduced even to disappearing. The full character of the structure is unfortunately only brought out in broad well-developed rings, and it is by no means rare to find a specimen with which nothing can be done, because no ring is broad enough to show the structure of the autumn wood. Search then always for the broadest ring.

The chief point then to be noticed is the presence or absence of true pores, which may be recognised by their abundance in the inner side of the ring. They are never more abundant in the autumn wood, even when uniformly occupying the whole section. If pores appear in the outer or middle part of the ring while the inner is free from them, be sure that they are resin pores, and that the wood you are dealing with is a conifer, and probably a pine or spruce. The rays are always present, even when microscopic, but they vary greatly in breadth, height, lustre, straightness, &c., each detail having its own particular value. The specimen of oak you have in your hands has extremely broad rays which are lustrous

and of considerable height on a tangential section, but in the transparent section of maple attached to the little cards, they are only just visible to the naked eye. Even these are broad comparatively to those of the horse chestnut and many conifers. As a rule, the narrower the rays in a transverse section, the shorter or shallower they are in other sections—that is, the proportion of breadth to depth is remarkably constant.

The year's growth of wood is well indicated in each ring of both oak and maple, but in quite different fashion; the former has bold pore-rings of one or more rows, following on the somewhat pore-less autumn wood of the previous year, whereas the latter has a very fine, perfectly distinct line of autumn wood, and the pores, instead of rapidly diminishing outwards almost to vanishing point, and assuming a tree like form, are of uniform size and somewhat sparingly scattered over the small areas formed by the regular cutting of the annual rings by the rays. A close examination of the small oaken block will reveal a number of cloudy bands running concentrically with the annual rings. These are composed of wood parenchyma, or soft tissue as I shall call it, and are usually present in well-developed rings in all the oaks. The two examples I have selected belong to two distinct types. I chose them as being particularly suitable for the purpose of showing the very different forms the various parts of the wood can assume, but they are only two amongst hundreds of types, for the arrangement of the four elements, the rays, the pores, the annual rings, and the soft tissue, is almost infinitely varied.

One of the difficulties of this study is the unending fluctuation of the size in the various parts, which is the outcome of the influence of age, soil, and climate, that is to say, of the vigour of growth. The variation which most meets the eye, that of the annual rings, has already been referred to. Next to this the coarseness of the pores chiefly affects the appearance of a wood. This depends more upon age than upon nourishment, and in many woods, such as the oak, the average size of the pores augments from year to year till the tree reaches its prime, and then becomes more or less constant. Other woods show their variation in a much less degree. This makes accurate measurement difficult, in fact a statement that the average diameter of the pores of the oak is a certain fraction of a millimetre is really useless as a guide, therefore Nördlinger, and after him Brandis and Gamble, adopted the method of using a series of well-known woods and employing them as standards with which to compare others; each type thus shows its own limits, and the measuring process becomes an estimate of the range of fluctuation in size. This is a simpler process than it seems, and in practice all that is necessary is to have a set of thin sections or shavings between two pieces of thin glass, which may be laid upon the section or even the solid wood of another specimen, and the size of the pores, &c., as ascertained by direct comparison. In all cases where the structure of a wood has to be

described in words, the largest pores or rays in each ring are only regarded, and the size is expressed by figures which indicate the minimum and maximum size of these largest elements only as found in rings of varying age. The reason of this is obvious. The pores are found to diminish in every ring, sometimes only a little, as in the maple, but more frequently to vanishing point as in the oak.

There is considerable harmony in the variation of the characters of wood, both physical and anatomical. The weight per cubic foot, the hardness, the state of saturation, amount of ash, the elasticity, &c., vary regularly, according to age and distance from the root of the tree. Weight is found to increase from the foot to the first branches, and then to decrease from that point upwards. The size of the rays, cells, and vessels, as already stated, increases with age, so that in the 80th yearly ring of an oak, counting from the pith outwards, these parts will be much larger than in the first. It must be borne in mind that the 80th ring was produced 79 years later than the first, so that we must be careful not to confound the age of the tree with the age of its wood.

Similarly, inasmuch as the sapling oak of one year is but a fractional part of the weight of the mature tree, and as the growth in height has been caused by the super-position of additional coats of wood one upon another, like so many cones, it follows that the wood of the upper parts must be younger, and therefore the innermost ring of this upper wood must not be assumed to be old because of its position. It is natural to assume this, and many would count the rings on a piece of wood from the upper part of a trunk, and pronounce it to be of such and such an age, whereas that may not be within fifty years of the truth.

Many tropical woods show scarcely any perceptible division between the growth of one year and the next. Their growth seems free from any check, though it may vary in vigour. Hence the familiar ring-boundaries become vague or entirely lost; even the rise and fall in the size of the pores is frequently absent, and they seem to increase uninterruptedly from the pith outwards to the bark. This state of things is found in quite a number of unrelated tropical South American woods, though it is by no means confined to them. I have often wondered if any of our European evergreen trees, such as the holm oak (*Quercus Ilex*), if acclimatised in a tropical region, would lose their characteristic rings, and take upon themselves this uniform structure of wood. No doubt the climate would modify it somewhat, and it has been urged that this circumstance vitiates the value of the anatomical characters for purposes of classification. True! as regards the succession and dimensions of each zone or its component parts, but their structure and arrangement remain the same, and will always stand good.

In many natural orders the soft tissue, which is so prominent in concentric circles in the oak, affords us great assistance. It appears in a multitude of forms, and may be found in little narrow

circles or borders round the pores, which show on a vertical section as cloudy margins to them. It may expand from these circles laterally into wings forming a spindle-shaped patch, in the midst of which the pore may be embedded. These wings may widen until they meet others, and join up to form circles concentric with the rings, straggling oblique lines, or long undulating wreaths. The lines may become narrowed to microscopical fineness, making a mere network with the rays, or may be broad conspicuous bands. In fact, from mere ill-defined scraps the soft tissue can vary to elaborate tracery. It is somehow or other closely connected with the natural affinity or relationship of woods, and more often than any other character helps us to guess at the place of a species in the natural system, but (there is invariably a "but" in connection with these details) it is not rarely absent in a genus or species, where one would most expect it. Gamble relies upon this feature in his artificial classification of the Leguminosæ, and it works beautifully within the limits of the Indian species, but it fails entirely where a larger range of leguminous plants is taken, especially in respect to those of temperate climates. He relies especially upon the width of the bands of soft tissue, but in applying it I have so often met with intermediate gradations of breadth, that I am forced to conclude that its use in this order must be restricted to small groups of species only. The extremely fine bars which may be seen crossing the rays in the ebonies, and the somewhat different bars characteristic of the lancewoods and many others, hold good over large numbers of species, so that it becomes a matter for investigation to find out in which particular form it may or may not be relied upon.

The vertical sections, *i.e.*, the radial and tangential sections, will often elucidate obscurities of structure, and give one a very clear idea of the structure of wood as a whole. I think one obtains a more securely based conception of what wood is by commencing to study it in the solid instead of by macerations, or even thin sections. To study the cells first under high powers is to my mind beginning at the wrong end. The microscopic part of the work is one of the higher walks of the science, and is better led up to by way of the study of the wood *en bloc*. I have met but few botanists who have anything but a vague idea of what wood in general is, when viewed under the microscope as an opaque object. Beautiful as the wonders revealed by the microscope notoriously are, I scarcely think anything more gorgeous can be found than that which some of our woods will afford. The preparation is so simple—a plane, with a keen iron, or even a sharp pocket-knife, is all that is required, and a smooth and clean-cut surface will not only show you an unexpected play of colour, but will demonstrate the relation of cell to vessel, and vessel to ray, in a manner impossible in a thin section in which one endeavours to separate the desired layer from all the deeper-seated tissue. Wood is much more transparent than one would think, and the subjacent cells

appear distinctly below those immediately on the surface, therefore the relations of each cell in every direction become evident. These show every variation of amber, ruby, gold, rich browns, and black and bright translucent beads of resin, which flash in the light like jewels that tempt one to forget one's work for the indulgence of the eye.

With all the additional aid which the anatomical characters give, we are not a great deal further advanced until we have some system of arriving step by step at the wood we desire to identify. It would be rash to enter upon the controversy concerning the systematic value of these characters, and to attempt to bring them into harmony with Orders and Genera. The time for this is not yet, but for technical purposes the natural system need only be respected as far as it is useful. Therefore, an artificial system will serve our turn.

The key provided by Nördlinger makes a mere commencement, and after guiding us a little way, leaves us stranded in the midst of a large group of species which have to be dealt with one by one. The key to the European woods constructed by Hartig, and the similar one by F. Schwartz are complete, and fairly satisfactory, but are so very limited. I have used all three, and can candidly say that they are much better than nothing, but require considerable study and much practice to use. For my own use I have constructed a key on a similar principle, but use different characters for the preliminary stages. As it seems to me, amongst the woods of the broad-leaved trees, the rays are the most constant character. I base my divisions upon them, first separating those woods having two kinds of rays, as many Cupuliferae, from those which have but one. I then divide the latter into those whose rays are separated by intervals greater or less than the transverse diameter of their larger pores, that is to say, the intervals between some may be equal to the pore-diameter at the most, and conversely in the other class the intervals may be equal to the pore-diameter, but never less. Further sub-divisions, which it would be tedious to detail, are based upon the presence of soft tissue and its arrangement, followed by the arrangement of the pores, concluding with the degree of definiteness of the ring-boundary. This most elusive character is one of Nördlinger's preliminary divisions, hence the difficulty of using his scheme.

The principle I have tried to follow is to start from plain or fairly obvious characters about which there can be little doubt, and to leave the more dubious ones for the end of the series, where there are fewer species to deal with, and other aids come in. By this system members of the same genus having a similar arrangement of rays, pores, and soft tissue, fall into the same ultimate group, which they do not when the ring-boundary is relied upon (vide *Platanus acerifolia* and *occidentalis*). When these ultimate groups are reached, physical and chemical characters may be employed in discrimination. The range of the weight per cubic foot,

hardness, colour of the solution produced by boiling in water and alcohol, reaction with iron salts, capacity for absorption of water, phenomena produced during burning, character of the surface, whether dull or lustrous, and the particular elements, rays, pores or ground tissue which produce the effect, and lastly, the colour.

In every description of wood, by a practical man, the elements of weight, hardness and colour come in. Sometimes the weight per cubic foot is given and the colour, apart from its fluctuations, is often accurately pictured, but the hardness is a quality which is practically left to our imagination. I have been so much impressed with the necessity of some means of measuring the degree of hardness, that I have constructed an instrument which is capable of giving a fairly accurate reading of the resistance to impact of a wood (not of its hardness pure and simple, because the resistance to impact is made up of elasticity *plus* hardness), but it is a fair parallel to the impression of that which we call the hardness makes upon our sense of touch. I will not weary you with a description of this contrivance, but will merely mention that the principle is as follows. A steel ball of a known weight falling a definite distance upon a surface at an angle of half a right angle will fly off in a horizontal direction, and describe a curve or trajectory which will be longer or shorter according to the amount of force absorbed by the wood. A self-recording arrangement and all necessary adjustments are attached to the machine. The hard and soft zones of a wood give different reading, so that a number of trials have to be made and an average struck. I take the average of ten trials, displacing the wood five millimetres between each.

The solution obtained from boiling a small quantity of shavings is of a valuable and interesting character, full of surprises, and affording many lovely colours. The reaction with iron salts is useful in cases where the change of colour is displayed in different degrees by different kinds of tissue. The burning of wood often causes various coloured resins to exude, and affords evidence by means of the aroma, or by the ash. A familiar example is the smell of the well-known Chinese joss sticks, made from the sawdust of sandalwood, and the two Australian paving woods, jarrah and karri, may be known by their producing a black cinder and a white ash respectively.—*Journal of the Society of Arts*.

I have read with much interest Mr. Herbert Stone's paper on the above subject, and would like to be permitted to make a few remarks as an addition to a discussion at which I was unable to be present.

First of all, a small personal matter. My "Manual of Indian Timbers" was several times referred to in very kind language, but both in Mr. Stone's paper, and in the remarks upon it by Dr. Schlich, there is some misapprehension regarding the responsibility of the descriptions of woods given in it. I feel sure that Dr. Schlich was not properly reported, and as, possibly, Mr. Stone

had not read my introduction, I propose to give the full extract from page ix., written in November 1881. The "writer" was, of course, myself:—

"It is now necessary to explain how the descriptions of the woods were made. During the progress of the work of preparation of specimens in Calcutta, and afterwards at more leisure in Simla, the examination of the different woods and their description was made by a committee which consisted of—

"1. Dr. D. Brandis, F.R.S., C.I.E., Inspector-General of Forests.

"2. Mr. J. S. Gamble, M.A., Assistant to the Inspector-General of Forests.

"3. Mr. A. Smythies, B.A., Assistant Conservator of Forests, Central Provinces.

"The descriptions were usually dictated by Dr. Brandis, and written down by one of the others, generally Mr. Smythies, but the wood structure was examined by all three officers, and discussed before the description was finally passed. The whole was gone over three or four times, and in the later examinations, when the committee was more accustomed to the differences of structure, the generic and family characters were discussed and drawn up. Some of the later-received specimens, as well as those given in 'Addenda,' were described by the writer, but on the same plan and principle as was originally adopted by the committee."

In referring to the chief works on the subject of the description of wood, and giving keys to enable them to be identified by their more easily-seen characters, Mr. Stone omitted to mention what is, in all probability, the most important, if not the earliest, book on the subject relating to European woods—the "*Flore Forestière*" of Mons. A. Mathieu, late Professor of Forestry at the Forest School at Nancy, France. The first edition of Professor Mathieu's work was published in 1858; it was followed by a second and third, the latter in 1877; the fourth edition, issued since Professor Mathieu's death, with complete revision, by his successor, Professor Fliche, appeared in 1897. In the "*Flore Forestière*" the wood descriptions are given with the genera, supplemented, where necessary, for the species; and at the end of the book is a detailed analytical key, which, in my opinion, is much better than the keys given by Professor Nördlinger and Professor Hartig. I can also recommend to Mr. Stone the excellent key to English (and some Indian) woods given in "*Timber, and some of its Diseases*," the very useful little work by Professor Marshall Ward, F.R.S., of Cambridge, published in the "Nature Series."

I cannot agree, and I do not think that Indian botanists of any branch will agree with Mr. Stone's complaint that "botanical explorers" omit from their descriptions the useful products of the plants. Of course, in large general floras like the "*Flora of British India*," it would be impossible to insert such things, but, with such exceptions, nearly every Indian botanist has given,

perforce briefly, economic information. Roxburgh's "Flora Indica" is an excellent case in point. If Mr. Stone will study the "Dictionary of the Economic Products of India," by Dr. G. Watts, C.I.E., probably the most complete work of the kind prepared in any country in the world, he will see what Indian botanical explorers have done for the economic products of the country. In the "Manual of Indian Timbers" the wood specimens collected by Dr. Wallich were all examined and mentioned, as were the more recent collections of Sir D. Brandis, Mr. S. Kurz, Colonel Ford and others. In my new edition about to be issued I have included also the collections of Sir J. D. Hooker, Mr. H. N. Ridley (Malay) and others, deposited at Kew; and one of my chief regrets is that the collection of the Brothers Schlagintweit could not also be included, because the names have been lost. What has been done in India, of course, I know more intimately, but I also know that Colonial British explorers have not deserved to be accused of neglect, and that the work done by the French and the Dutch has been as good as, indeed if anything better than our own.

I think that in his remarks about Kew, Dr. A. Henry was not quite just. I have been recently working in the Kew Museum, and have been struck with the care taken to incorporate in it the woods sent by various correspondents. As I was not specially interested in Chinese woods, I can say nothing about Dr. Henry's collections, but they are doubtless there ready for him or another to work up. The authorities at Kew were most kind in their help to me, and were delighted that I should work in the museum, but it is abundantly clear to anybody who inquires into the matter that the present miserably inadequate and ill-paid Kew staff could not be expected to do wood descriptions for explorers in addition to their own work. The Kew collections are national and the herbarium and museum are maintained by the State not only for study by the staff of the establishment, but to be conveniently at the disposal of workers in general. There are, unfortunately, not many specialists in the study of woods, and it is very good news to those interested in the subject that Mr. Stone is going to devote his scientific life to it. His paper was very interesting, and I, for one, shall eagerly look forward to the results of his further work.

December 9th, 1901.

J. S. GAMBLE,

(in *Journal of Society of Arts.*)

Humus as a Preservative against Frost.

I HAVE just read a French translation, by my old friend Prof. Henry of the Nancy Forest School, of Wollny's classic work on the decomposition of organic matter. In it I find the statement that spring and autumn frosts are dangerous on peaty soils only when the surface of the latter is dry. Wollny gives no illustrations of this law, but I recently observed one in my garden at Cooper's Hill.

Last September I dug up several rose beds on my lawn and sowed them with grass-seed, which has produced a fine crop of young grass. This I carefully watered, and the soil in the beds was well trenched and covered with decomposed leaf mould before the seed was sown. The rest of the lawn has not been trenched, probably for thirty years, and the soil under the grass in it, a stiffish loam, is now singularly dry for the time of the year.

On the morning of December 6th there was a slight frost, 31°F. being registered six inches above the grass. At 8 A.M. the lawn was white with rime, except on the new grass, which remained green.

This must be due to the fact that the moist, well-trenched humus soil under the new grass was able to conduct heat from below and thus kept the air in contact with it above the freezing-point, while the dry, compact loam under the old turf could not supply sufficient heat to the old grass to preserve it from freezing. Dry humus, according to Wollny, has a low specific heat, and is a bad conductor, while wet humus has a high specific heat, and is a good conductor of heat. On another occasion when snow fell, it melted much sooner on the new grass than on the rest of the garden.

As a further illustration of Wollny's law I may cite the fact that water is let on to cranberry swamps in Carolina when frost is feared during the blossoming period, and also that in north-west India, on clear evenings when frost is feared, vegetable gardens and sugar-cane plantations are irrigated in order to obviate danger from frost. Kikur (*Acacia arabica*) plantations in the Punjab are also irrigated when frost is feared.

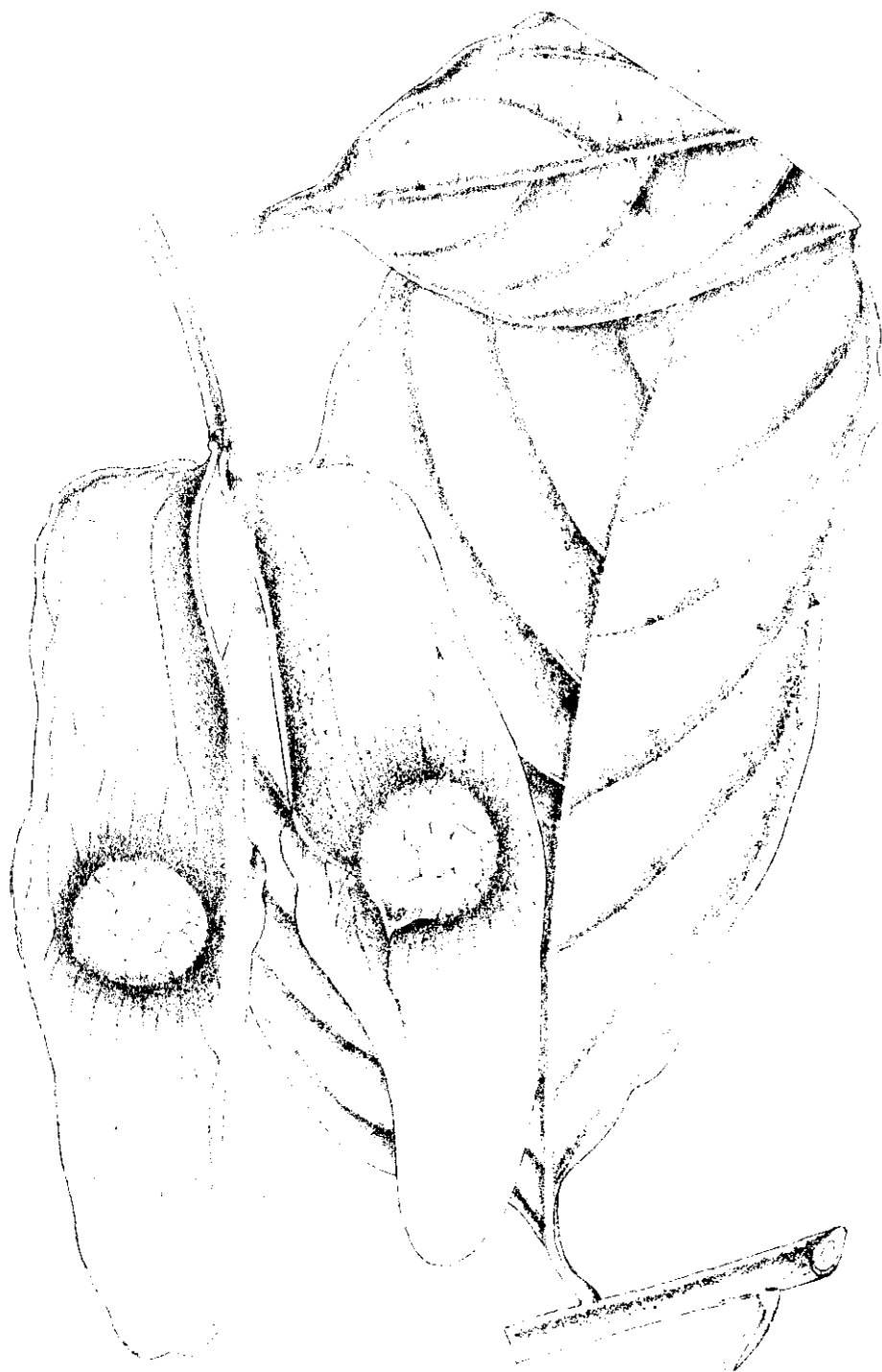
It is also well known in Germany that if a sphagnum peat bog is to be reproduced, a thin layer of peat must be left at the base of the bog after the upper peat has been removed, and this layer kept carefully under water, as otherwise the drying up and consequent freezing of the peat will kill the moss.

Slight frosts are very prejudicial to vegetation in sub-tropical forests, and, when frost is imminent, the precaution of trenching the soil, removing weeds and irrigating cultivations is extremely important for young sugar-cane and other crops.

Cooper's Hill, December 8th.

W. R. FISHER

VII.—TIMBER AND PRODUCE TRADE.



C. N. Chaudhuri del.

ABIANTHUS CRANTII FRANK

K. P. Das sculp.

THE INDIAN FORESTER.

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[No. 4

An Undescribed *Ailanthus* from North-Eastern India.

By D. PRAIN.

WHEN examining the material of the genus *Dalbergia* at Kew in 1899, the writer found, at the end of the genus, a single undetermined fruit, with which is associated two notes in the handwriting of General Jenkins, at one time Agent for the Governor-General on the North-Eastern Frontier, who was untiring in his efforts to investigate the Natural History and exploit the resources of Assam. All that the writer could say regarding the fruit was, that it is not the pod of a *Dalbergia*.

More definite information was soon available; for, in 1900, Mr. Cave, of the Bengal Cinchona Department, sent to Calcutta a specimen, in leaf and fruit, of the very tree that had been once met with, half a century earlier, in Assam. Flowers unfortunately we have not yet been able to get, but the leaves and the fruit show that it is unmistakeably an *Ailanthus*, and a comparison of our specimen with the *Ailanthus* material at Kew and at Calcutta indicates that it is a species hitherto unreported from India, Indo-China or Malaya. With the object of attracting the attention of Forest officers and others in Sikkim and Assam to what is evidently a fine tree, a description of the species, as complete as the material yet available will permit, is here given. Three plates are added; one shows a leaflet and the fruit of this new species, the others, for purposes of comparison, show leaflets and fruits of the other species to be met with in India.

AILANTHUS GRANDIS *sp. nov.*; arbor elata, *foliis* compositis, *foliolis* alternis utrinque glaberrimis basi obliquis margine integris, *samaris* majusculis, stramineis, oblongis utrinque obtusis, basi rectis.

ASSAM: Rungagora, *Jenkins*. SIKKIM: Ryang, *Cave*. A lofty tree, reaching 120 feet in height. *Leaves* alternate, 60—106 cm. long; leaflets alternate, oblique, ovate-lanceolate, with shortly acuminate apex and obliquely cuneate base, 16—20 cm. long and 8 cm. wide, glabrous on both surfaces, with 10—12 pairs of secondary nerves, their margins entire. *Panicles* large, their branches 15—16 cm. long; pedicels in fruit 4 cm. long. *Flowers* unknown.

Samaras 2-3, with rounded obtuse apex, and base rounded to outer straight on inner margin; length 11—13 cm., width 3.5 cm. *Seed* near middle of samara, 1.5 cm. across.

The Assamese name is given as *Actaluca*; no vernacular name has been reported from Sikkim.

General Jenkins' first note is:—"No. 45, *Actaluca*. The "seeds of an unknown tree in and about Rungagora; one of the "most noble of forest trees. The one from which the seed is "taken is so high that we cannot get at the leaves, the nearest "branch being perhaps 80 feet high. I hope one or two of the "seeds may vegetate." This note was not improbably addressed to Dr. Wallich, then Superintendent of the Calcutta Botanic Garden. Apparently none of the seeds did germinate; this was unfortunately our experience with those from the Ryang in 1900. The second note, written a year later, is: "The tree has been measured by Masters, and he makes it exactly 120 feet high, but the "natives say it is only a very small one of its kind." The Masters referred to in this note is Mr. J. W. Masters, then a Deputy Commissioner in Assam, well-known for the extent and the excellence of the collections and notes made by him in that province between 1835 and 1845. Rungagora, the old capital of the Máták country, according to Griffith is, or was, situated one march east of Dibrugarh.

The other species of *Ailanthus* to be met with in India are:—*A. glandulosa*, a native of China, but now met with in Europe, North America and Northern India as a planted tree; *A. excelsa*, a well-known Indian tree, found wild throughout South India and Central India, and extending as far north as Chutia Nagpur on the east, and Rajputana on the west, but occasionally planted also in Northern India and Bengal; finally *A. malabarica*, found in Western India between the Ghauts and the coast from the Concan and Kanara to Calicut and Travancore, as well as in Ceylon.

A. malabarica is also said to occur in Cachin-China; but this is not admitted by Pierre, who describes two Cambodian trees, *A. Fauveliana* and *A. calycina*. Of these *A. Fauveliana* is evidently nearly related to *A. malabarica*, and may be the Cochin-Chinese species mistaken for *A. malabarica*. The excellent figures and careful description of Pierre leave, however, little doubt that this is a distinct species. *A. calycina* has a calyx very unlike that of *A. malabarica*, and is undoubtedly a different tree. In Pegu, Kurz found in the Khaboung valley on the eastern slope of the Yomah, the fruits of an *Ailanthus* which he identified with *A. malabarica*. No one has found this, or any other, *Ailanthus* in Pegu since, but numerous examples have been sent to Calcutta of a species that is apparently common in S. Andaman, the samaras of which are exactly like those of the Pegu tree. They differ markedly from the samaras of *A. malabarica* in being more distinctly veined and in being glossy instead of dull. Their tips are also decidedly



D. N. Chaudhari del.

A. AILANTHUS GLANDULOSA Desf. B. A. EXCELSA BAIL.

A. N. Sengupta.



D. N. Chaudhary del.

A. A. ANTHUS MALABARICA DC. B. A. KURZII Prain

K. P. Datta lith.

more twisted than those of *A. malabarica*, but this character, it is to be feared, cannot be greatly depended on in herbarium specimens. The flowers, however, differ considerably from those of *A. malabarica*, as there is usually present in the males a rudimentary ovary with a slender style almost as long as the filaments. In the flowers of *A. malabarica* and *A. imberbiflora* examined by the writer, the males have either no ovary at all, or if a rudimentary ovary be present there is no long slender style. This appears to be the case also in the nearly allied *A. Fauveliana*, and in another tree from Java described by Koorders and Valeton as *A. malabarica* var. *mollis*. This Pegu-Andaman tree the writer is therefore inclined to consider a distinct species to be known as *A. Kurzii*. There is, however, possibly another Indo-Chinese *Ailanthus*. After having seen the solitary samara of *A. grandis* at Kew in 1899, the writer showed a drawing he had made of it to the late Mr. Franchet, and discussed with him the possible affinities of the tree that had yielded it. That learned botanist was able at once to refer to some very similar fruits in the collection of Mr. Drake del Castillo, where also they had been tentatively referred to *Dalbergia*. These fruits were picked up by Balansa under a great tree in Tonkin, of which he could not obtain leaves. They more resemble the samaras of *A. grandis* than they do those of any other species, but though larger than those of *A. malabarica* and its allies, are smaller than those of *A. grandis*. They may prove to be the fruits of *A. calycina*, the samaras of which are still unknown, but they may equally possibly belong to still another undescribed species.

In Malaya two species are met with. One is the tree from Java already alluded to, which has been referred by Koorders and Valeton to *A. malabarica*. The only fruiting specimen of this that the writer has seen has the samaras unfortunately not yet full grown. They resemble, however, much more the samaras of the Andamanese *A. Kurzii* at the same stage than they do the corresponding samaras of *A. malabarica*. From *A. Kurzii*, however, the Java tree is, by its flowers, certainly distinct, and if an opinion can be formed from a careful examination of two specimens, the Java *Ailanthus* is still another species which may be known as *A. mollis*. It belongs undoubtedly to the same group as *A. malabarica*: within that group its nearest ally is, however, not *A. malabarica* or *A. Kurzii* but *A. Fauveliana*. The other Malayan *Ailanthus* is *A. moluccana*, one of the earliest species reported, but even now one of the least adequately known. Finally there is in N. Australia still another species, *A. imberbiflora*. It has been suggested that this Australian tree is a variety of our Indian *A. excelsa*; it is, however, more nearly related to *A. malabarica* than to *A. excelsa*, but is easily distinguishable even from *A. malabarica*.

The geographical distribution of the genus is thus very interesting. Except *A. glandulosa*, which is the type of a

distinct section and is Chinese, all the species are confined to the botanical region of S.-E. Asia—India, Indo-China, and Malaya, with the adjacent territory of N. Australia. But while the genus as a whole is very wide-spread in this region, the various forms that comprise it are remarkably localised. The Malabar country—S. Ceylon, Travancore, Malabar and the Concan—has *A. malabarica*, limited to this region. India proper has *A. excelsa*, found everywhere throughout the peninsula, but neither passing beyond the Ghauts to the west nor beyond the Gangetic plain to the north. *A. grandis* occurs at the foot of the Eastern Himalaya in Sikkim and Upper Assam. In Indo-China we have similarly *A. Kurzii* confined to Pegu and the Andamans, and *A. Fauveliana* confined to Cambodia. The species met with in Tonkin may be another distinct one, or may possibly be the same as *A. calycina*, which is also a Cambodian form. In Western Malaya we have *A. mollis*; in Eastern Malaya, *A. moluccana*; and in N. Australia *A. imberbiflora*. The absence of the genus from the Philippines and New Guinea, so far as we yet know, does not preclude its presence entirely. It would be no matter for surprise were species to be reported from both localities when their vegetation becomes more adequately known.

Of the three plates here given, Plate I represents a leaflet and fruit of *A. grandis*; Plate II, leaflets and fruits of *A. glandulosa* and *A. excelsa*; and Plate III, leaflets and fruits of *A. malabarica* and *A. Kurzii*. The fruits and leaflets are, in each case, of natural size; the leaflet selected is, in every instance, the third leaflet, counted from below, of a full-sized leaf. It is found that there is some variability in the size of the two lowest leaflets in leaves of the same specimen; this variability does not affect the third leaflet, hence the selection.

— — — — — *A. malabarica*

Hill Forests of North Coimbatore.

By A. W. LUSHINGTON.

THE forest reserves of the Northern, or hill, ranges of north Coimbatore have the following areas:—

	Acres.		
Doddasampagai, its extension, and Guligi (also an extension) ..	65,111	Acres 466,662 or sq. m. 729	Kollegal Range.
Bailur, Odayarpalayam, Jadatalahalla, and Dodda Induvadi (Sandal) ..	1,877		
Chikkailur ..	53,760		
Yeddaralli, Hanur, and Karudhalli, Maddeswaranmalai ..	188,480		
Talamalai, its extension, Sirganhalli, and Akkujorai ..	157,440	Acres 184,661 or sq. m. 288	Talamalai Range.
Nilgiri Eastern slopes ..	126,421		
Gutialatur, its extensions, and enclosed reserves (Gesmalam, Ullepalayam, Barebetta). ..	58,240		
Vellamundi ..	191,960	Acres 202,637 or sq. m. 317	Sattymangalam Range.
North Bargur and Pamarakurai ..	10,677		
South Bargur ..	127,025	Acres 223,025 or sq. m. 349	Bhavani Range.
Talamalai ..	71,680		
	24,320		

The Palamalai reserve forms an isolated hill range on the banks of the Cauvery river, rising to 4,924 feet above sea level, the plains at the foot being about 750 feet above sea-level. With this exception, and that some (e.g., Ullepalayam and Barabetta) have been formed within areas left originally inside others as enclosures, all the other reserves join one another in a continuous mass of forest. Talamalai joins the north of the Nilgiri eastern slopes; Gutialatur joins the east of Talamalai; Doddasampagai joins the north of Gutialatur; Yeddaralli joins the north of Gutialatur and east of Doddasampagai; Hanur joins the north of Yeddaralli; Maddeswaranmalai joins the north-east of Yeddaralli; Kavadhalli joins the west of Maddeswaranmalai and the north of Yeddaralli, Chikkailur joins the west of Maddeswaranmalai and north of Kavadhalli; North Bargur joins the south of Maddeswaranmalai and the east of Yeddaralli; South Bargur joins the south of North Bargur and the east of Gutialatur; whilst Tamarabarai lies between North and South Bargur, joining the former on the south and the latter on the north. Without enclosures the forest area of these reserves amounts to 1,673 square miles. This does not include Erode range, which consists of purely plains forest; but which belongs to North Coimbatore, and has a forest area of 24 square miles, lying in three different taluks (Erode, Karur, and Dharmapuram).

NATURE OF THE COUNTRY.

Talamalai is the westernmost, Bhavani the easternmost, and Kollegal the northernmost range; Sattyamangalam range lies east of Talamalai, south of Kollegal, and west of Bhavani Range. Talamalai range is bounded on the east and north by Nilgiri district and Mysore; Kollegal, on west and north by Mysore, and east by Salem district; Bhavani, on the east by Salem district. The hills form generally a series of plateaux, ranging from 2,500 to 6,000 feet above sea level, often intersected with deep ravines, and generally with steep gradients to the plateau above, the gradients ranging from 1 in 3 to 1 in 10. Besides being broken up with ravines, the plateaux often are made still less level by some portions being projected upwards as small hills above the general level. Almost all the hill ranges run north and south; the streams sometimes run north and south, sometimes east and west. After getting above ghats, the general slope of the country is towards the north or north-east; and the slopes towards that side are comparatively gentle, whilst towards the south they are steep. Below ghats, the general slope of the country is towards the east, all the drainage running into the Cauvery river. All the drainage above ghats also runs into the Cauvery river, which forms the north and eastern boundary of Kollegal, and eastern boundary of Bhavani taluk. The principal affluent of the Cauvery, just below ghats, is the Bhavani river, which flows at the foot of the Nilgiri eastern slopes, Gutialatur

and South Bargur reserves, and flows into the Cauvery at the town of Bhavani. The Mayar flows between the Nilgiri eastern slopes and Talamalai reserves, and joins the Bhavani near Kottamangalam, 10 miles west of Sattyamangalam. The Palar forms the boundary first between Gutialatur (and Sattyamangalam taluk) and South Bargur (Bhavani taluk); then between Yeddaralli (Kollegal) and North Bargur (Bhavani); finally between Maddheswaramalai (Kollegal) and north Bargur (Bhavani). Several fairly large streams from the Sattyamangalam and Kollegal hills flow into the Palar. The Gundila, a perennial stream, flows northward from the Doddasampagai hills into the Cauvery; and in the Hassanur valley several streams (the most important of which are the Minchigali and Mavahalla streams) flow into Mysore, and thence into the Cauvery. The Sigatti nalla forms the boundary on the west between Talamalai and Mysore, and falls into the Mayar.

TALAMALAI RANGE.

The Nilgiri eastern slopes form a small plateau about 5,000 feet above sea level, sloping to the north into the Mayar, to the east and south into the Bhavani river, forming thereby a horse-shoe. The Talamalai reserve forms a central plateau of 3,000 feet, sloping northwards to Mysore gently, and steeply southwards into the Mayar, with hilly plateaux, east and west of the central one, of some 4,000 feet.

SATTYAMANGALAM RANGE.

Adjoining the Talamalai eastern hill plateau is the small Hassanur plateau, about 4 miles square. East, south and north of this, and adjoining the Talamalai eastern hill plateau at Dimbham at the top of the ghats, is a plateau of about 4,000 feet (Aiyangiri, Doddabetta and Kotriboli, being hills of upwards of 5,000 feet projecting from it) which may be called the *Geddesala* plateau, and includes the Minchiguli plateau; this extends northwards from Dimbham, about 20 miles and is on the average about 6 miles broad, but the Minchiguli plateau, which adjoins this between the Hassanur plateau and Mysore, is about 7 miles long and 6 wide. East of the Geddesala plateau is the Yekkatur plateau, 10 miles from east to west by 6 miles from south to north, falling from 2,900 feet on the south-west to 1,700 feet on the north-east. East of this is the Gundri Plateau, about 3,500 feet, extending about 6 miles each way, and terminating on the south and south-east in high hills of 5,000 to 5,500 feet, (Yeggaribetta, Malliammadurgam, Urugamalai and Kambatrayan). South of the Geddesala, Yekkatur and Gundri plateaux, the hills slope away abruptly to the plains. North of the Gundri, Yekkatur and Geddesala plateaux is the Germalam plateau of about 3,500 feet, about 12 miles east and west, by 4 miles.

KOLLEGAL RANGE.

North of the eastern end of Germalam plateau are the Yeddaralli and Hanur reserves, a very much broken up plateau of about 3,500 feet; whilst west of it is the Bailur plateau, falling from about 3,200 feet on the south to 2,000 feet on the north, about 12 miles long, north and south, and 3 miles wide. The Doddasampagai reserve comes west of this with two ranges of hills (half of the western belongs to Mysore) varying from 6,000 feet on the south to 4,000 on the north, with the Gundila valley between them. North of these comes the Kollegal plain, about 1,800 feet, about 24 miles east and west, by 12 miles north and south. The Chikkalur hills, about 3,000 feet, come north of this, the Karudhalli hills, about 3,000 feet east of it, and the Maddeswaranmalia hills about 3,500 rising to over 4,000 feet east of the Kamdhalli hills.

BHAVANI RANGE.

The North and South Bargur and Tamarakarai reserves form a plateau of 3,600 feet, deeply intersected with ravines. The Palamalai reserve, as before stated, is an isolated range.

COMMUNICATIONS.

Two roads were constructed in byegone years by the D. P. W. through the whole of these hills. One from Kollegal *viâ* Lokanhalli, Bailur, Geddesala, Hassanur, Dimbham, and Bennari to Sattyamangalam. The second from Kollegal *viâ* Ramapuram, Girgagandi, Tattakarai, Bargur, Tamarakarai, Sellampalayam to Bhavani. The ghat portions of these roads were laid out at far too steep a gradient, some parts of the first being 1 in 11, even at places where there are zigzags. The consequence is that they are constantly being washed away, and their surface becomes thus impassible. These roads have been for some years taken over by the Forest Department, which, from reasons given above, labours under great disadvantages with them. A forest road was constructed from Kollatur, north of Talamalai reserve, just into the North Bargur hills, but does not extend into them. A bridle path was constructed from Dimbham to Talamalai (now under conversion into a rough cart track); and another was constructed from the Kollegal road up the Gundila valley. With these exceptions there is not a single cart track of any description through the reserves; and the footpaths mostly go from the hills into the deep valleys and ravines below them. It must be remarked that very frequently, within half a mile to a mile from their source, the streams often form valleys from 500 to 1,000 feet below their starting point. In these circumstances it may be readily understood that communications are practically nil, and that transport in the present circumstances is well nigh impossible.

BUILDINGS.

In Talamalai range, there is an Inspection house and Range office combined at Talamalai, a tiled shed at Chikkalli, and a small bungalow (formerly belonging to the D. P. W.) on the roadside near Hassanur. These are all forest bungalows, whilst there is a local fund bungalow at Dimbham; a combined bungalow and hospital at Talavadi, and practically uninhabitable chatrams at Gejjebhatti, Bennari and Velamundi; and a police bungalow at Kottamangalam. Mr. R. H. Morris, of Attikkhan Estate, has a small bungalow at Punjur, just north of Talamalai reserve, which he has kindly placed at the disposal of Forest officers. In Sattyamangalam range there are forest bungalows at Geddesala and Germalam, and a shed at Yekkatu; and a local fund bungalow at Sattyamangalam. Kollegal range is the best off in this way, with forest bungalows at Bailur, Bellaji, Lokanahalli, Ramapuram, Karudhalli, Martaballi, Sengadi, Ponachi, Gopinattam; local fund bungalows at Kollegal, Ujjipuram, Singanallur, Ramapuram; and a jaghir bungalow at Sivasanudram. In Bhavani there are forest bungalows at Tattakarai, Tamaraharai and Sellampalayam; and a local fund bungalow at Bhavani. Forest bungalows have been sanctioned to be built during 1902-3 at Yekkatu and Kalkadambur in Sattyamangalam range, and a number of temporary bamboo and thatch sheds have during the last two years been put up (costing about Rs.50 each), 2 in Talamalai range, 5 in Sattyamangalam range, and 1 in Bhavani range. The whole division badly wants opening out in this respect, owing to the difficulty in the way of communications; and perhaps these temporary sheds are the best kind to begin with in order that suitable sites may be ultimately selected.

NATURE OF THE FORESTS.

This division contains forests of a more heterogeneous nature than I have ever come across in such a limited area, and the number of valuable species is very numerous. The species that has received the most attention is the sandal (*Santalum album*). Besides this, however, there are teak, blackwood, vengai (*Pterocarpus marsupium*), *Shorea Talura* (*laccifera*), *Hardwickia binata*, *Ougeina dalbergioides*, *Gmelina arborea*, *Stereospermum xylocarpum*, *Terminalia Chebula*, *Terminalia tomentosa*, *Eugenia Jambolana*, *Acrocarpus fraxinifolius*, *Cedrela Toona*, *Chickrassia tabularis*, *Melia dubia*, *Melia azadirachta* (*indica*), *Anogeissus latifolia*, *Chloroxylon Swietenia*, *Bassia longifolia*, *Bassia latifolia*, *Mimusops hemandra*, *Mimusops Elenji*, *Mimusops Roxburghianus*, *Schrebera swietenoides*, *Stephegyne parviflora*, *Vitex altissima*, *Briedelia retusa*, *Cassia Fistula*, *Albizzia odoratissima*, *Albizzia pedicellata*, *Albizzia Lebbek*, *Acacia Sundra*, *Acacia leucophloea*, *Acacia Suma*, *Acacia ferruginea*, *Schleichera trijuga*, *Grewia tiliaefolia*.

SANDAL.

The sandal seems to be a species of paradoxes. It grows luxuriantly at Markampalayam at an elevation of 1,600 feet, and at Kotadai at an elevation of over 4,000. It grows on hard, dry soil between Yekkatur and Kadhatti, and on soft damp soil along perennial streams near Bailur. It grows on red loam and on black loam. It appears to grow best, when young, under cover; when older, in the open. It is found quite in the open; but it also occurs in some of the densest thickets of *Scutia*, *Zizyphus* and bamboo. It comes up fairly abundantly from seeds dropped by birds; but stubbornly refuses to do so when sown by human beings. It is destroyed in large numbers by fires; but plants are found growing luxuriantly on fire lines, which are burnt annually. It is eaten when young by cattle; but it appears to grow most abundantly in the vicinity of villages, and especially along tracks frequented by cattle. It ordinarily dies when the bark is stripped; and yet near Talakara there is a flourishing young growth from suckers, where the back of the semi-subterranean stems has come off from the portion above ground. It ordinarily is found on flat ground and gentle slopes; but is also found on steep gradients, provided, however, that, in both cases, there is sufficient depth of soil. The area which it covers in this division (which is included not only in the reserves, but also in the cultivated lands adjoining them) is worked departmentally, as the sandal has become the property of Government, and forms a kind of broken T, of which the downstroke strikes northwards from Yekkatur (Sattyamangalam) to Lokanahalli at the north end of the Bailur plateau (Kollegal), and the bar runs across from Palamalai on the west to Madan (east of Tamarakarai in the Bargur hills in Bhavani range). There are, however, some isolated patches in the Maddeswaranmalai reserve; and the steeper slopes within the T contain no sandal. The total area covered by the sandal in this division is roughly 130 square miles. It grows sometimes very gregariously; at other times much scattered. It is only within the last six or seven years that it has been worked in a systematic fashion. At present there are five working circles, tentatively formed, two in Kollegal and one in each of the other three ranges, called Bailur, Maddeswaranmalai, Talamalai, Gutialatur, and Tamarakarai sandalwood working circles. Each of these working circles is divided into ten coupes except Gutialatur where there are 13. Each year one of these coupes is taken in hand, and all mature, dead or dying trees (sandal) are numbered and marked with tar, and the measurements entered in a register. Trees are considered to be mature when they have a girth measurement of 42 inches; and dying when they cannot be expected to live until another rotation. To assure sufficient reproduction, all the immature trees in the coupe are likewise counted, but not marked. To facilitate enumeration, the ground covered by a coupe is gone over and a plan made.

showing all the natural features—paths, streams, &c.; and the coupe is then divided temporarily into sub-coupes. Enumeration has to be done in the sub-coupes in proper succession, one sub-coupe being entirely completed and worked in systematic order before the next sub-coupe is taken up. The next year the fellings are done; and this, too, is conducted in the same systematic order, taking each tree in its turn and each sub-coupe in its turn; all roots over 2 inches diameter have also to be taken up; and it must be noted that reproduction from suckers is best from roots; so cut, left in the ground under 2 inches in diameter; when the larger roots are taken up, seeds are dibbled into the holes so formed. Immediately after a tree is felled, it is cut up into suitable billets, each billet and root receiving the number of the tree and a subsidiary letter, and is then registered with its dimensions in a register. The billets are then first rough-chipped, to take off the sapwood, then fine-chipped and polished to bring them to a marketable state; but the billet number is always left on, or, if necessary to remove it, painted on afresh immediately after removal. Until recently the sandalwood was sold direct to Messrs. Pierce, Leslie & Co., who have secured a good name for Coimbatore sandal, but as it was considered objectionable to give them a monopoly, they have now been appointed as agents to the department to ship the material to Europe, and sell it there on behalf of Government, receiving a commission on the proceeds. The outturn from the division annually amounts to about 8,000 to 10,000 maunds of 25lbs., say 100 to 120 tons of cleaned wood. The local value is about Rs.6 per maund of 25lbs.

TEAK.

Owing to the intensity of the fires that have occurred in this division, there are now no sound large teak trees. There are large trees in several places, *e.g.*, Talakarai (Bhavani), Minchiguli (Sattyamungalam) and elsewhere; but they all have their bark cracked for a long distance down the bole and a stag-headed and generally unhealthy appearance. The teak mostly occurs in small gregarious patches, and even many of the young trees have been greatly damaged by fires, but there is often a fair crop of seedlings, for which it is hoped a better future is in store. Near Ponnachi in the Maddeswaranmalai hills a really fine young pole forest of teak is reported to exist. It is most abundant in the Bargur forests, and in Doddasampagai reserve; but is also found on the Geddesala plateau in Gutialatur reserve, on the east Talamai hill plateau, in ravines of the Nilgiri eastern slopes, and on the slopes to the plains from the Gundri plateau. Refuse,—it can hardly be termed otherwise,—consisting of old dead or burnt trees and stumps, is taken to Kollegal depôt, and fetches a ready sale at a rupee a cubic foot.

BLACKWOOD.

Large blackwood is rather scarce, but some fine trees exist near Geddesala, in the Minchiguli plateau; and in the Gundil

valley, and other parts of the Doddasampagai reserve. Small trees, although sporadic, are fairly abundant, and appear to come up, chiefly from suckers, along roads, demarcation lines, fire lines, &c., whenever the forest has been opened, and it is also often found on the banks of streams.

VENGAI.

Like teak, the vengai has been terribly damaged by fires, but there is still a fair quantity of large, though often much damaged, material left in the forests. In parts there is an excellent reproduction of young growth. It would seem as if the fires had not so great an effect in exterminating vengai as teak, for in some parts—(e.g., Palamalai eastern hills) where the forests have been so absolutely ruined by fires, that no undergrowth but dwarf dates is left—there exist still a few large dilapidated looking vengai. The localities where vengai still exist in considerable numbers and of large size (though damaged) are Doddasampagai reserve, Geddesala and Minchiguli plateaux of Gutialatur reserve, and some parts of the Talamalai eastern hills, but in the Bargur forests they appear very scattered.

SHOREA TALURA (LACCIFERA).

This tree grows gregariously on some parts of the Palamalai hills, and there is a small patch near Germalam. The trees seldom attain more than 3 feet and sometimes 4 feet girth; usually they are of small size from young shoots to 6 or 8 inches diameter. It is very evident that both graziers and fires have done a great deal of damage, as almost all the trees are either coppice or pollard shoots. Even the larger trees seldom have the straight unbranched stem of *Shorea robusta*, but fork into 2 or 3 branches not very far from the ground; the branches do not spread out but are mostly parallel. The species is in great favour locally but, being a reserved tree, it may not be felled except under special orders of the District Forest Officer.

HARDWICKIA BINATA.

This occurs gregariously in the Phaddeswaranmalai reserve and Chikkailur reserve (eastern portion) along the northern and north-eastern slopes down to the Cauvery river; also in the eastern portion of the Yeddaralli reserve, and on the western, northern and eastern slopes of north Bargur reserve, and throughout the Palamalai reserve. In Maddeswaranmalai it is said to attain 16 feet in girth; but a specimen of 10 feet girth which was brought in to Kollegal proved to be quite hollow. Small quantities are also found on the southern slopes of the Gutialatur (Sattyamangalam) and Palamalai reserves, especially just above Gejjalhatti. It is almost invariably accompanied by *Boswellia serrata*. The young growth looks very promising; but

the species grows on the slopes where the fires would spread very easily and which are usually very dry.

OUGEINIA DALBERGIOIDES.

This is by no means common in the forests of this division, growing only sporadically except on the Dimbham ghat between the 16th and 17th mile from Sattyamangalam, where there is a gregarious patch, chiefly suckers, very few being over 6 inches in girth.

STEREOSPERMUM XYLOCARPUM.

This grows sporadically in Gutialatur, Palamalai and North Bargur reserves; but there is a small gregarious patch in the first named reserve near Uppukerai.

GMELINA ARBOREA.

This can scarcely be called gregarious, yet there are large quantities of it over the greater part of the moister hills. Trees of 4 feet girth are not uncommon.

TERMINALIA CHEBULA.

This is one of the most abundant trees in the forests throughout this portion of the division. Since the protection afforded by the Forest Act of 1882 the old trees have been strictly preserved, and young saplings have been able to come up all over the place, and there is a magnificent crop of young trees just coming into bearing. Gall nuts (*myrabolans*) from these form one of the principal items of minor forest produce in the division, and will be referred to under that head.

TERMINALIA TOMENTOSA.

This is not very abundant, and is chiefly confined to the higher and damper localities, especially in the Gundila valley of Doddasampagai reserve (Kollegal), in the Minchiguli and Geddesala plateaux of Gutialatur reserve (Sattyamangalam) and in a few localities, chiefly near streams, in Palamalai eastern hills plateau. Mr. R. H. Morris, of Attikhan Estate (Mysore), tried to extract some sleepers from the trees growing in the Minchiguli valley but found a very large percentage heartshaken, probably owing to the fires which have devastated that forest.

EUGENIA JAMBOLANA.

Huge trees of this species, often 8 to 10 feet in girth and 60 to 80 feet in height, are found along streams and in other damp localities, notably on the edge of a long swamp between Geddesala and Bailur.

ANOCARPUS FROXINIFOLIUS.

This is said to occur in the Gundila valley near Bellaji (Doddasampagai Forest, Kollegal).

CEDRELA TOONA; *CHICKRASSIA TABULARIS*.

Cedrela grows in the moister localities of the Gutialatur, Doddasampagai, Talamalai and North Bargur reserves. It is very scarce in the two latter; but near Geddesala it is fairly abundant, and there is an excellent crop of seedlings coming up. *Chickrassia* is very scarce near Geddesala; but it is said to grow in the Minchiguli valley, and in the Gandila valley (Doddasampagai reserves).

MELIA AZADIRACHTA (INDICA) AND *DUBIA* (COMPOSITA).

The former is exceedingly abundant in the lower slopes adjoining the plains, in and on the edges of cultivation adjoining the reserve, in patches of old cultivation and in the drier and more open portions of all reserves. *Melia dubia* is found occasionally scattered; there are some large trees near Bailur, some near Belimugai (in Yekkatur enclosure of Gutialatur reserve), some near Hassanur and some near Tamarabarai.

ANOGEISSUS LATIFOLIA.

This forms large patches of gregarious forest all over the hills, except in the parts which contain *Acacia Sundra*. It sometimes grows to large size, trees of 6 feet girth and over having been met with, but usually it is in the form of poles from 6 to 10 inches in diameter. There are very few localities, however, in the division in which it is sound: the constant fires have made it knotty externally, and full of heart shakes and dry rot internally. In the North Bargur forest, however, there seem to be some well grown tall poles of 6 to 8 inches diameter. When sound, it is greatly appreciated for cart axles and rafters, and even house poles; it is elastic and has a great transverse strength, and withstands concussions, and this is what make it so suitable for cart axles. Used for poles and rafters, it is generally left in the round with the bark and sapwood on and in this state it is liable to be attacked by boring beetles. Nevertheless, if it were not for the damage done by fires, there would be a large supply of poles of this species.

BASSIA LATIFOLIA AND *LONGIFOLIA*.

Both of these are found scattered about in the forests, but are not common, and the latter is very scarce.

MIMUSOPS HEXANDRA. *ELENGI*, *ROXBURGHIANUS*.

Mimusops hexandra and *Roxburghianus* are common near Talamalai in the cut-up ground near the bungalow, and other similar localities near streams with gentle gradients and sandy beds. *Mimusops Elengi* is found near streams (in Talamalai and Gutialatur reserves) with steep gradients and rocky beds.

SCHREBERA SWIETENIOIDES.

This is commonly met with almost gregariously in places, on the steeper slopes forming the transition from one plateau to another, such as those from Hassanur to the Talamalai eastern

hills plateau. When sound, it is used for oil-presses, &c. ; but it occurs chiefly where fires are worst, and seldom is sound.

STEPHEGYNE PARVIFLORA.

There is a fair amount of this species, but it is very scattered, growing mostly near tanks and on the edges of streams. It often attains 6 and 8 feet girth, but is not much used.

VITEX ALTISSIMA AND PUBESCENS.

There is a large quantity of these scattered about sporadically, often attaining large size, chiefly in the moister forests.

BRIDELIA RETUSA.

This is exceedingly common, and constitutes the principal species in conjunction with *Terminalia chebula*, in the portions of forests where teak, vengai, &c., have been burnt out, and in the areas moister than those on which the *Hardwickia* and acacias chiefly grow.

CASSIA FISTULA.

This is very common, but rather sporadic, as an undergrowth in the forests in which teak, vengai, &c., grow. It is used for poles, and sometimes the bark is used for tanning.

ALBIZZIA ODORATISSIMA AND PEDICELLATA.

These are common in the hill forests ; the former being exceedingly so everywhere ; the latter apparently being restricted to certain localities, *e.g.*, between Geddesala and Germalam, and near Sengulam (North Bargur). They grow very straight but seldom large.

ALBIZZIA LEBBEK.

This is a characteristic species of the plains, of the lower slopes bordering on the plains and also of the flat ground in or bordering on existing or abandoned cultivation. It also grows on the banks of streams generally where the forest has been opened out. It is much used in the plains for carts and house-beams, there being no objection locally, as exists in some parts of the presidency, to its use inside houses.

ACACIA SUNDRA.

This forms a large percentage of the crop in Chikkailur, in the south of Maddeswaranmalai, in Yeddaralli, on the lower slopes of North and South Bargur and to some extent in Gutialatur and Talamalai reserves. Cutch (market rate, £35 to £55 per ton) is obtainable from this, although it is not used locally for the purpose ; but in Kistn enough to fill a half pound biscuit tin was made as a sample which fetched Rs.26. This was the result of 11 small stunted trees. The wood is used locally for ploughs, beams, and agricultural implements. It grows on dry stony soil very gregariously.

ACACIA LEUCOPHLOEA AND *SUMA*.

The latter, with its white papery bark, is very local, there being fairly large quantities of it near Hassanur. The former grows on the edges of cultivation, or in patches which have previously been under cultivation, and in such places is abundant; but in the forests it generally only grows on fairly level ground where the forest is somewhat open.

ACACIA FERRUGINEA.

This grows in fair abundance, mixed with *Acacia Latronum* and *Albizzia amara*, in the forests of the lower slopes adjoining the plains in Talmalai, Gutialatur, and Bargur reserves. It is esteemed locally for building and agricultural purposes.

CHLOROXYLON SWIETENIA.

This grows largely in association with *Acacia ferruginea*, *Albizzia Lebbek*, *Melia Azadirachta*, &c., in the lower slopes, and also on the drier steeper slopes in the hills, sometimes with *Hardwickia*, sometimes with *Bridelia*. It has been much cut about and pollarded, as it is largely used for ploughs and other agricultural implements; it is mostly small, being a slow grower, and is found in dry localities and in localities very much subjected to fires.

SCHLEICHERA TRIJUGA.

This is found on the moister slopes of the hill forests, but not in abundance.

GREWIA THLICEFOLIA.

This forms a large percentage of the forest growth in vengai forests, but has been very much damaged by fires. It seldom grows over 6 or 8 inches in diameter.

SAPINDUS TRIFOLIATUS (SOAPNUT).

This grows in fair abundance in the forests, especially in the more open ones, and there is a fair quantity of it on the Dimbham ghat.

SOFT-WOODED TREES.

There is a large quantity of *Kydia calycina* in the vengai forests; as previously remarked, *Boswellia serrata* usually found in conjunction with the *Hardwickia*, and often *Cochlospermum Gossypium* is likewise so associated. *Cochlospermum*, and also *Givotia rottleriformis*, *Gyrocarpus Jacquini* and *Protium caudatum* are found in abundance on the southern slopes of the Bargur, Gutialatur and Palamalai reserves. *Phyllanthus Emblica* is ubiquitous, and together with *Zizyphus xylopyra* prominently to the fore where fires have destroyed other better species.

FIREWOOD.

There is, in prospective, a line of rail from Erode to Nanjangud via Sattiyamangalam, Gajjalhatti, and the Talamalai plateaux, with

a branch from Sattyamangalam to Mettapalayam. Should this become an accomplished fact, the forests at the foot of the hills, viz., parts of Gutialalur (with its extension), Talamalai (with its extension), and Nilgiri eastern slopes, and the Vellamindi reserve will serve admirably as a fuel-supply for this railway. The area available for this purpose would be some 42,000 acres. The forest growth consists of Acacias, Albizzias, Zizyphus, Melia, Chloroxylon, Swietenia, and others. For the past five or six years coupes have been opened near Bennair for the supply of Sattyamangalam town, and the result has given a yield of from 9 to 13 tons per acre, a very good outturn, so that if a rotation of 40 years were decided upon, there should be an annual supply of some 10,000 tons. At Sivasamudram, on the Kollegal Mysore frontier, electric works are being installed, which will require a large amount of firewood; the exact quantity is not yet known. At present those works are obtaining their supply from Sivasamudram jaghir, but it is understood that the jaghir forests cannot stand the drain on their resources, and it is probable that the supply will ultimately have to be made from the Chikkailur reserve. The subject at present, however, is under enquiry.

BAMBOOS.

The large hollow bamboo grows very well along almost all the streams in the hills; it ordinarily attains a diameter of 3 to 4 inches, but in the Maifar valley it reaches 5, 6, and even 7 inches diameter and these are often used for milk pails. The large bamboo is not at present very much in demand, firstly, because the cost of extraction and transport precludes the sale from being large in the existing state of communications; and secondly, owing to the length of time required for transport it is difficult to get them into the best markets in a green state, the condition in which they are most readily sold. On the hills, away from streams, the bamboos are mostly of the hollow kind, but seldom more than 1½ to 2 inches in diameter; the solid bamboo is, however, also found in fairly large quantities. There is a considerable demand for both the smaller hollow and the solid bamboo; but here, again, the difficulties of extraction prohibit a very large sale, and a great deal of the district supply is met from the Salem district. Bamboos are extremely abundant in almost all parts of the forests; they appear to form an intermediate condition of the forests under the influence of forest fires. Where there are no fires, the high forests oust the bamboo, a condition seldom met with; where the fires have made considerable openings in the forest growth, and the soil, after having been caked, is rendered shallow, the bamboos abound; finally when the fires have created havoc among the bamboos, they die out, and their place is first of all taken by rank grass and then by dwarf dates, with a certain amount of Zizyphus, Phyllanthus, Glochidion, and

a few other stunted trees. Bamboos do not grow on the steepest slopes from the Talamalai and Gatialatur plateau to the plains, but wherever the gradient becomes gentler and a certain sufficiency of soil exist they abound.

MINOR FOREST PRODUCE.

The chief items of minor forest produce in the division are myrobalans, beeswax, vembadam bark (*Ventilago*), avaram bark (*Cassia auriculata*) deer horns, tamarind, gum, honey, soapnuts, leekoy (*Acacia concinna*). Until three or four years ago these were all leased out to contractors, but it gave room for frauds, especially in connection with sandalwood, which was illicitly taken, so that the produce had to be collected departmentally, with the exception of avaram bark—an essentially ultra-reserve produce. It has been found that the collection of all except tamarind, gum, honey and soapnuts by departmental agency is financially more profitable; those excepted are liable to go bad, or, at all events, the cost of collection, clearing, storing, &c., is not paid for by the value realised. Tamarind is again leased out, and the other items are not collected. Myrobalans form a very important item, the value realised from these alone amounting to from Rs.15,000 to Rs.20,000 annually and owing to the large number of young trees now coming into bearing, the realizations are likely to increase. Hitherto it has been difficult to check removals from the forests, as the collecting agents were in the habit of bringing down the produce to the Range head quarters depôt unpacked, and it was there only that the removals were accounted for; but it is more than probable that a great deal of the removals did not find their way to the depôts at all. Now the forests have been divided, as far as it is possible to define them without cut lines, into blocks; and a certain place within each block has been selected for the forest depôt. To this place the collecting agents,—mostly Sholagars, Irulas, and such hill men,—bring the produce, and there it is sorted, and paid for by special supervisors recently appointed for the work. The supervisors then pack it in gunnies or tins, each package containing an integral number of maunds, seal the packages with a special seal provided to them, enter the details in the register, with the depôt number, marks, weight, &c., on the package and forward it in this condition to the Range depôts. The supervisor pays a heavy security, and is personally responsible for the classification of the produce, which is merely stored in the headquarter depôts until the time of sale, when the seals are broken by the Range officer in the presence of the supervisor. Any produce brought out from the forest in a loose condition is therefore removed illicitly; and action can at once be taken.

PAST WORKING.

Owing to the extreme difficulty of transport, due to the almost total absence of communications, and the intense ruggedness

of the country, but little has been done so far in the way of working these forests. The method of working the sandal has already been described. When the coupes are situated near the roads that exist, the sandal is brought down on carts, there being in some parts a most useful kind of cart with solid wooden wheels, called a Wodder or Gobara cart, which is so balanced that it can go down gradients of 1 in 10, and one wheel can pass over a stone $1\frac{1}{2}$ feet higher than the other wheel, without upsetting. If the sandal is not obtainable immediately alongside the road, it is carried by headloads, either to a road or straight to depôt. The sandal from the Talamalai, Gutialatur, and Baikur, working circles is sent direct to Sattyamangalam, where there is a large depôt building (cost Rs.7,000); and is sent thence to Coimbatore to Messrs. Pierce, Leslie & Co. That from Wadheswaranmalai and Tamarabarai working circles is sent direct to Bhavani (it is usually a comparatively very small amount), where Messrs. Pierce, Leslie & Co. take delivery of it. As regards other timber not much is at present being done. In Kollegal, about 2,000 cubic feet, mostly of dead wood, have annually been extracted from Doddasampagai Reserve, and consisting almost entirely of teak, vengai and karumadadr (*Terminalia tomentosa*); whilst in Bhavani it was proposed to extract 500 cubic feet of acha (*Hardwickia*). It was ultimately decided, however, not to take out the living acha until we had more definite plans for working. As regards firewood, in Talamalai range a coupe was opened, but was soon closed as there was found to be no demand; the same took place in Doddasampagai reserve near Kollegal, and in South Bargur Reserve in Bhavani. In Sattyamangalam alone coupes have been fairly satisfactory: one at Kongarampalayam was opened, which had to be closed in the same way as those before mentioned; one at Kanahampalayam was opened, and took six years to work out, a fresh one being opened during the current year; but at Bennari the coupes, although too large, have done fairly well. Seven coupes were marked off; the first two 150 acres each, the last five of 90 acres each. The first coupe took three years to work out, the second coupe was worked over 102 acres in two years, and the remaining 50 acres being found inaccessible, was closed without working. The third coupe took two years to work; and as it was found that the demand required about 45 to 50 acres, the other coupes have been divided into two each, one worked each year. In bamboos, originally the permit system was in vogue, but it was found that under plea of cutting bamboos a great deal of sandalwood was illicitly removed; so in Bhavani an attempt was made at locating fellings by coupes, whilst in Sattyamangalam departmental extraction was tried. Neither of these arrangements were quite satisfactory. Owing to the maladministration of a bad Range officer in Bhavani, and the difficulty of constant inspection on the part of the District Forest Officer owing to the magnitude of the division and the difficulty of getting about, it was found

that more bamboos were cut outside the coupes than inside. In Sattyamangalam it was found that the department could not cope with the demand, the labour thrown on the already overworked Range officer was enormous, and the realisations only exceeded the expenditure by Rs.1,000 whilst the bamboos were not extracted from coupes, but from wherever the bamboo-cutters, who brought them into depôt, pleased. In Bhavani also departmental fellings were also tried, which resulted in financial loss. As a matter of fact, the establishment is too small to undertake such work at present, and the quantity of bamboos is so enormous that no very great amount of damage could be done to them by fellings. *As a temporary arrangement*, therefore, the permit system has been re-adopted on the outer slopes of the Talamalai and Sattyamangalam hills (not amongst the sandal areas), and in Bhavani certain blocks have been leased to a contractor. This is giving better financial results, but it must be understood that the return to the old policy is only intended to be temporary until other works have been carried out. The mode of working minor forest produce has already been detailed under "Minor Forest Produce."

MODE OF FUTURE WORKING.

In such a heterogeneous mass of forest it is extremely difficult to say what should be the mode of future working. There are, however, three points which are prominently noticeable, and they are—(1) the reserves in their present condition are far too large and unwieldy for proper working, or even for finding out what the true nature of the forest growth existing in them is; and they should be divided up; (2) the fires are simply ruining them, and vigorous action must be taken to protect them; and (3) the lines of communication are so few and so bad, that a large number of new lines must be opened out as soon as possible. It is proposed, therefore, to accomplish these three ends in one operation, *viz.*, by making "block lines," and "compartment lines." There are three guiding features which assist in the selection of these lines; firstly, to adopt such gradient that the block lines could ultimately be converted into good roads or cart tracks, and the compartment lines into cart tracks, at least, suitable for wooden carts. Secondly, to divide up the reserves into blocks and compartments containing as far as possible the same species; and thirdly, dividing up the reserves into more or less equal portions, and of such a size that if a fire occurs in any one portion it can be kept in ordinary circumstances under control, so as to prevent it spreading to the next portion. This will be a tedious operation, owing to financial considerations and the magnitude of the divisional and range charges, and will take very many years to complete. It will be readily understood, from what has been mentioned, that there is a large amount of dead and dying wood of the better kinds existing in the forest; and at present they merely serve as fuel to the annual conflagrations. As the block

and compartment lines are extended, it will be possible to extract these; and in the interests of the forests, they should be extracted. Whilst this extraction is being carried out, enumeration of the standing crop, and the cutting of creepers might be made simultaneously. The creepers are often very detrimental. They consist chiefly of *Zizyphus ænophia* and *rugosa*, *Sentia indica*, *Acacia Intsia* and *pennata*, *Pterolobium indicum*, *Cœsalpinia sepiaria* and *Bonducella*, *Toddalia aculeata* (and probably a new species), *Derris* (two or three different species), *Mimosa rubicaulis* and *hamata* and *Convolvulaceæ* of different kinds. Enumeration should take place a year or two prior to felling, in order to have estimates ready and creeper cutting could be done simultaneously with the enumeration; the extraction and burning of creepers, and of all useless wood, being done the wood is taken out for sale.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Camphor.

THE recent establishment by the Government of Japan of a monopoly of the production and sale of camphor in Formosa, has attracted much attention to this product, and at the same time, by raising the market price, has rendered it by no means unlikely that this may prove to be a profitable cultivation in Ceylon. The present circular is issued to lay before the planting public the chief facts connected with this industry, and to describe the methods of cultivation and preparation which have been found best suited to Ceylon in the experiments so far tried with this tree.

The total export of camphor to Europe and America is perhaps about 60,000 piculs annually, or 8,000,000 lb. The market value of crude camphor in Europe is at present about 155 shillings per cwt., or about 1s. 4½d. per lb. Camphor was formerly used chiefly as a drug and for the prevention of insect ravages in clothing, &c., but of late years, in addition to these uses, it has been largely employed in the manufacture of smokeless powders and of celluloid. The tree also produces an oil,—obtained with the camphor in the preparation of the latter, and which is used in the manufacture of soaps and for other purposes.

BOTANY.

Common Formosa, Chinese or Japanese camphor is the product of *Cinnamomum Camphora*, Nees, a tree occurring native along the eastern side of Asia from Cochin-China to Shanghai, and in the islands from Hainan to South Japan; its limits of latitudinal range are from 10° to 34° N., but it is cultivated in Japan to 36° N. In the southern parts of its range it occurs chiefly in the hills.

Two other forms of camphor are frequently met with, though rarely exported to Europe. Barus, Bhimsaini, Borneo, or Malay camphor is the product of *Dryobalanops camphora*, Colebr., a large tree of the family Dipterocarpaceæ, occurring in the islands of Sumatra, Borneo, &c. This camphor is slightly heavier than common camphor, and is highly prized by the natives of India and China, who purchase the entire very small produce at fancy prices, from 100 to 200 shillings per pound. A third form, Nagai, or Blumea camphor, is prepared in south-east China from *Blumea balsamifera*, one of the family Compositæ. In Ceylon the natives prepare a small quantity of camphor from the roots of cinnamon, *Cinnamomum zeylanicum*, a plant nearly related to the true camphor. In the remainder of this paper only the common camphor, *Cinnamomum camphora*, will be dealt with.

In its native country the plant grows into a tree about 100 feet high with a trunk 2 to 3 feet in diameter. It is evergreen, with moderate sized laurel-like leaves, which when crushed smell strongly of camphor. It may be well to mention in this connec-

tion that the tree is very handsome when young, and forms one of the best ornamental trees for roadside, parks, compounds, &c., in Ceylon.

The native habitat of the species is not widely extended, but it has been successfully cultivated in Ceylon, India, Australia, Florida, California, and elsewhere. It was introduced into Ceylon by the Royal Botanic Gardens in 1852. In 1895 plants were largely distributed from Hakgala to many planters and others. These were the result of seeds obtained in the autumn of 1893 from Japan. Mr. Nock, Superintendent of Hakgala, has collected information about these trees, some 950 in all, and reports as follows:—

“During 1895 plants of camphor were distributed from Hakgala to planters in various parts of the island at elevations ranging from 250 to 6,450 feet, with annual rainfalls varying from 54 inches on 104 days to 217 inches on 212 days. Replies as to the growth of the plants have been received from thirty localities, and I think it is pretty well proved that under certain conditions of soil and climate camphor will thrive at all elevations in Ceylon from about sea level to the highest mountains.

“It appears to thrive best in a well-drained deep sandy loam in sheltered situations with a rainfall of 90 inches and over, and dislikes poor or close, stiff, undrained soil. The growth is slow in sterile soil, but, under favourable conditions, in good soil is very rapid, the tree reaching a height of 18 to 20 feet in five years, with a spread of branches of 8 to 12 feet and a stem of 6 to 7 inches in diameter. This compares very favourably with the growth of the trees in their native habitat, where a tree, 30 feet high and 6 inches in diameter at ten years old, is considered good. The best five-year old tree (from planting) in Ceylon is at Veyangoda, at an elevation of about 100 feet with a rainfall of about 100 inches on 180 days. It is 25 feet high and growing luxuriantly. The next best are at Hakgala, where the largest is 20 feet high, with a spread of 13 feet, and a stem diameter of $7\frac{1}{2}$ inches at the ground.

“The habit of the trees in Ceylon in good soil is bushy, with a tendency to throw up many stems. This is a point of importance, as it shows that the tree will coppice well and stand frequent cuttings or prunings, and possibly even plucking of the flush as with tea. In close, hard, undrained or stiff clayey soil the growth is poor, and the habit stunted or dwarfed, and this is also the case in exposed windblown situations.

“Of course it is only in the experimental stage here yet, but judging from my experience of it for some years, it is my opinion that as a minor product it should be grown in the form of hedges, planted at distances of 6 to 9 feet apart and 2 to 3 feet apart in the row. The rows should run north-west and south-east, or across the directions of the prevailing winds, and the plants be allowed to grow 6 to 9 feet high. Planted in this way there would be ample room for cultivation, and each row would shelter the other from the north-

east and south-east winds, besides forming a large surface for clipping. As the young shoots appear to yield the most camphor, the crop could be obtained by clipping the hedge with a pair of light shears, and the expense would be very slight. The trees might also be planted at 6 feet apart, and treated in the same way as tea bushes, or they might be planted 12 feet apart, and trained as pyramids, or again planted 4 feet apart and alternate plants coppiced in alternate years."

PROPAGATION, CULTIVATION, &C.

Mr. Nock states:—

"Camphor plants are best and easily propagated from seeds. The seeds do not keep well, and should be sown as soon as possible after ripening. They ripen in Japan, which at present is the only important source of seed, in October and November, and should be ordered some time in advance, so as to obtain them as soon as they are ripe. I find it a good plan to soak the seed in water for twenty-four to forty-eight hours before sowing, agitating the water occasionally. The best seeds being heavier, will sink to the bottom, and these should be sown thinly by themselves; the lighter ones should be sown thickly, as only a small percentage will germinate.

"The seeds should be sown in well-prepared beds of sandy loam and leaf mould; they should be sown from $\frac{1}{2}$ to $\frac{3}{4}$ inch deep, making the bed firm, but not tight. The beds should be kept shaded and just moist. Too much wet will cause the young seedlings to damp off, and if allowed to get too dry, the germs will quickly dry up and die.

"We have been most successful when the seed has been sown in boxes (made of $\frac{1}{2}$ inch wood) 18 by 13 by $3\frac{1}{2}$ inches, filled with the kind of soil described above. The boxes are handy to lift about, and can be easily protected from heavy rain and strong sun. Sheds made after the style of the old cinchona seed sheds answer well for standing the boxes in, and if made light and airy, would do well to sow the seeds in direct, but care should be taken not to allow the young plants to be 'drawn.'

"We find it a good plan to prick out the seedling into supply baskets as soon as they are large enough to handle comfortably, or transplant them into beds, placing the plants 6 inches apart every way, and keeping them shaded and watered until they begin to grow, when they will bear the full light of the sun, but will require to be freely watered in dry weather.

"When the plants are from 9 to 15 inches high, they are at their best for final planting; but if the weather is unsuitable, they may be kept in the nursery till they are 2 feet high, or until good planting weather occurs, viz., dull, showery weather. In such weather they require very little shading, and soon take hold of the soil.

"Cuttings do not strike root readily, and only under certain conditions will they be successful. If the prevailing weather

should be too dry, they soon go off, and if too wet and cold, they decay before roots are formed. We have had batches of cuttings with 70 per cent. beginning to callus over, and young shoots forming, that have gone off after three or four days of rough weather—cold, high winds and heavy rains—and others that have gone the same way after a week of dry sunny weather. The favourable conditions are equable heat, light, and moisture; with these, and wood for cuttings in a proper state, a large percentage will strike root and make good plants.

"The nursery beds for seeds as well as cuttings should be made in a well-drained situation, and as near water as possible. The beds may be any length, and from 3 to 4 feet wide. The soil for cuttings should be composed as follows: one part good sandy loam, one part leaf mould, and one part clean sharp sand (to this it would be beneficial to add a good sprinkling of powdered charcoal), all thoroughly mixed. The soil should be 6 to 9 inches deep. A layer of good sharp sand, one inch thick, should be laid on the surface. As a protection against hot sun and heavy rains it would be well to put a roof of thatch over the beds in the form of a shed, but it should be constructed with open sides to allow plenty of light and air. A shed, 4 feet wide, with a lean-to roof on stout posts, open at the back and front, will be found a useful size. The posts should be 6 feet high in front and 3 feet 6 inches at the back. The roof may be thatch, shingles, or other light material. If more than one is required, a space, 4 feet wide, should be left between the sheds to give room for watering, weeding, and general attention.

"The best material for cuttings is that from straight, healthy, and well-matured shoots of the current year's growth, not too soft or too hard. If too hard, they will not root readily, and if too soft, they will be liable to damp off. The cuttings may be of any size from the thickness of a lead pencil to $\frac{3}{4}$ inch in diameter. They should be cut into lengths of from 6 to 9 inches. A clean cut with a very sharp knife immediately below a joint to form the base of the cutting is of the greatest importance. If the cut portion is torn or jagged, or too far away from the joint, it is almost certain to decay, though it may remain green for a long time.

"The operation for inserting the cuttings is best done by opening a trench with sharp spade so as to form a straight edge. The prepared cuttings should be laid against this and the soil pressed firmly round them. They should be placed in rows 9 to 12 inches apart, and 3 inches apart in the rows, and at a sufficient depth to leave only two or three buds above the surface.

"The sooner the cuttings are made and put in after being taken from the trees the better. After the cuttings are put in, the beds should be watered to settle the soil, and if in the open they must be carefully shaded and sunlight must be only

gradually let in as they become rooted and can bear it. If all goes well, they should be rooted in 2 to 3 months, but they will not be ready for planting out for three or four months.

"Camphor may also be propagated by layers. The operation of layering is very simple. The shoots should be bent down to the soil. The branch at the bend should be cut half-way through, then cutting upwards for about $1\frac{1}{2}$ to 2 inches, so as to form a tongue. The cut portion must be kept apart by a slight twist, or by placing a piece of brick or a small stone in the cleft. The shoot should then be pegged down firmly into a groove made in the soil for its reception and covered with soil. The end of the shoot must be kept upright by tying it to a stick.

"Another simple way is to split the branch at the bend where it is to be laid in the ground, making the split about 2 inches long, and keeping the cut parts open by inserting a piece of wood or stone. Peg down well into the soil and stake. The ends of the shoots should be cut back a few inches with a sharp knife."

It is thus evident that the plant will thrive almost anywhere in the island if the water-supply be sufficient and the soil well drained. The best method of treatment is probably to grow it as hedges, which are easily managed and clipped. It may also be planted along roads, jungle edges, &c., but *should never be mixed with the tea*, as the young leaves are very like those of tea, and a twig or two of camphor will spoil a whole break of tea.

"The chief mineral ingredients required by the camphor plant for growth of leaves are lime and potash, an average yield of prunings removing 196 lb. of lime and 87 lb. of potash, which could be returned to the soil after the distilled wood had been burned for fuel purposes."

PREPARATION OF THE CAMPHOR.

As soon as the plants have reached a fair size and formed stout woody stems below—say in the three years or less in very good situations—they may be clipped. The simplest method will perhaps be to use hedge shears, placing a long basket below the hedge to catch the clippings. Only the leaves and young twigs are required; woody twigs yield little or no camphor.

In Japan, where, however, they only use the wood of full-grown trees as a source of camphor, the chips of wood are distilled in a primitive-looking but effective still, with bamboo tubes (these have the advantage that they can afterwards be split to remove any camphor from them) and a wooden condenser with water running over its lid. In Ceylon probably the best method will be to fix up a small still of any good pattern with a glass condenser and plentiful water-supply, working it by means of steam from the factory boiler. As the distillation is a somewhat

uncertain operation, especially to the beginner, and as it is probable that more efficient methods will be discovered, the details of the principal experiments tried are given below. Material for these experiments was obtained from the gardens at Peradeniya (1,600 feet), Hakgala (5,600 feet), and Anuradhapura (300 feet).

CAMPBOR DISTILLATION.

The first distillations were from 112 lb. of prunings received from Hakgala on the 28th June, 1910. These were conducted in a large cask fitted with a metal cover leading to a metal condenser, which was cooled by a constant flow of water. Distillation was effected by means of steam from a boiler, passing into the lower part of the cask below a perforated iron plate. The prunings were chopped up into fragments, about 1 inch long, covered with water, the top, connected with the condenser, luted on, and steam turned on to gradually bring the water to the boil.

A strong pungent smell of camphor and eucalyptus came off as soon as distillation commenced, which persisted for some time even when the distillate was cooled to 50° F., a temperature below that which could be obtained practically. The loss was minimized by bringing the water to the boil very slowly, and only admitting just sufficient steam to keep it at the boiling temperature. It was found that the metal cover to the cask retained a good proportion of the camphor, but it was not so pure as when condensed in a wooden box similar to that in use in China and Japan.

The purest camphor was obtained when the distillate was made to pass through a long glass tube surrounded with a jacket of cold (running) water, the crystals being deposited when the temperature of the glass did not exceed 50° C., or 122° F., a temperature that could easily be maintained in a condensing apparatus up-country at all times of the year. In the low-country a more rapid flow of condensing water and a proportionately longer condensing apparatus would be required to obtain the same results, as the water is much warmer and the steam also is at a higher temperature.

In all the experiments the camphor had almost entirely distilled over during the first three hours, as several distillations conducted for twelve hours and longer resulted in no better yield, and the smell of the camphor under these circumstances was contaminated with that of decomposition products from the nitrogenous matter, &c., in the leaves and twigs. Three distillations could be made in the same apparatus during the day.

The amount of steam required for the distillation even of large quantities would be nominal, and would hardly be felt in an ordinary boiler working in a tea factory.

YIELD OF CAMPHOR.

The first distillation from part of the prunings obtained from Hakgala in June 1900, only yielded 35 per cent., but this was raised to 62 per cent. by better regulation of the steam pres-

sure and the condensing water. The camphor had a slight smell of eucalyptus, and was not so strong as ordinary camphor. The leaves were quite fresh when distilled.

Separate distillations were again made in August with fresh leaves and twigs, and the green branches of about half inch to 1 inch thick, the former yielded .85 per cent. camphor, but the latter a mere trace, both of camphor and oil.

7th September 1900.—Three distillations of camphor leaves from Peradeniya were made in the usual manner, the yield from the first being 1.10 per cent. of camphor and camphor-oil. In the second distillation, when the leaves had partly dried, 1.06 per cent. of camphor and oil was obtained, calculated on the fresh leaves. In the third distillation the leaves had undergone partial decomposition, the result of becoming heated to a temperature of 106° F. The yield in this case was 68 per cent. camphor and .38 per cent. of oil, so that it would appear advisable to distil the leaves as fresh as possible, as the oil is less valuable than the camphor.

9th October 1900.—A sample of young camphor flush weighing 11½ lb., plucked from two trees in Hakgala, one 8 feet in diameter and 12 feet high, yielding 8 lb., and the other 5 feet in diameter and 7 feet high, yielding 3½ lb. This was carefully distilled in a copper retort over a lamp, and the vapour condensed in a glass vessel. In the first four hours .63 per cent. of pure camphor was obtained, which smelled only of pure camphor; on further distillation .08 per cent. more camphor was obtained, which did not smell quite so pure. Heating by the direct flame beneath the vessel appears to take longer in removing all the camphor than driving it over with steam under slight pressure.

24th October 1900.—A distillation of camphor clippings from Hakgala yielded .77 per cent. camphor and .27 per cent. oil.

30th October 1900.—A distillation of 12 lb. of camphor flush was made in a copper vessel with a glass condenser, yielded .69 per cent. camphor and .34 per cent. camphor-oil. The trees were in active growth when this flush was plucked.

9th January, 1901.—A camphor tree that had become slightly cankered was received from Hakgala in separate parcels of leaves, branches, stem, and roots. Several distillations of the leaves and twigs were made, both in the fresh state and when air-dried, some of them being continued for twelve hours. The yield of camphor and oil varied somewhat, but appeared to depend on the proportion of leaves to twigs, the latter containing much less than the former. A glass condenser was employed for all these distillations, the camphor and oil being obtained quite pure.

The first experiment yielded .875 per cent. camphor and .986 per cent. oil, a far larger proportion of oil than in any previous distillation of similar leaf.

A second distillation, which was continued at a low temperature for eleven hours, yielded 1.08 per cent. pure camphor and 0.32 per cent. oil.

Five other distillations at intervals of some days with the air-dried leaves gave the following yields:—

- No. 1.—2.310 per cent. camphor and .114 per cent. oil, equal to 1.02 per cent. on fresh leaf.
- No. 2.—2.149 per cent. camphor and oil, equal to .98 per cent. on fresh leaf.
- No. 3.—2.425 per cent. camphor and traces of oil, equal to 1.05 per cent. on fresh leaf.
- No. 4.—2.380 per cent. camphor and traces of oil, equal to 1.01 per cent. on fresh leaf.
- No. 5.—2.080 per cent. camphor and traces of oil, equal to .96 per cent. on fresh leaf.

From these figures it will be seen that air-drying the leaf before distillation does not cause any appreciable loss of camphor, though a certain amount of oil disappears, either by volatilization or oxidation. The camphor obtained from the air-dried leaf also had a somewhat purer smell than that from the fresh leaf, though this latter was easily rendered pure by re-distillation with steam.

Three distillations were made of the branches and stem of the camphor tree, but no appreciable quantity of camphor was obtained from either, nor did the bark of the stem appear to contain more than traces. The roots, however, contained an oil, 5lb. of roots yielding 1.22 per cent. This oil was located mainly in the bark and in a thin layer of wood beneath it. It had only a slight smell of camphor, and more resembled a mixture of aniseed and peppermint.

On the 7th August 1901, 5lb. of young flush was received from Hakgala in a slightly heated condition. It was at once put into a copper vessel with fifteen pints of water, and a glass dome luted on which was connected with a glass condenser. The water was heated slowly from below, and a thermometer placed, so as to register the temperature of the vapour 2 inches above the water and camphor leaves.

At 50° C. (122° F.) crystals of camphor condensed on the glass dome, which at 90° C. (194° F.) were carried back into the water by the condensed steam. At 100° C. the steam and camphor vapour was passing rapidly into the glass condenser, while the leaves were covered with oily drops of camphor and oil. Distillation at 100° C. was continued for two hours, when 4½ litres (7.93 pints) of water containing camphor and oil had collected in the condenser. This was then passed through a wet paper filter to separate the camphor and oil from the water, 24.53 grams of mixture being obtained, equal to 1.10 per cent. The oil was separated from the camphor as much as possible, the yield of each on the original flush being .755 per cent. pure camphor and .345 per cent. camphor-oil. Another distillation was made in the same way of 10lb. of coppice shoots one year old from a tree that

had been cut down. The yield of camphor from this was very small, only .192 per cent., and shows that the first year's growth from a tree cut down to the ground is practically valueless, but it is probable that young flush from such coppiced trees would increase in the camphor contents during the next and succeeding years.

Further distillations were also made of the entire prunings weighing 50lb. of a five year and nine months old tree of average growth, the leaves (27lb.) and branches (23lb.) being distilled separately, the former yielding .767 per cent. of pure camphor and some oil, the latter only traces of oil, showing that the whole of the camphor is practically in the leaves, and not in the young wood. The reason of this should be investigated, as it is from *old wood* that the bulk of the camphor of commerce is obtained.

CHARACTERS.

The camphor obtained from all the above experiments has the usual crystalline form, and is perfectly colourless unless condensed in an iron vessel, when it is tinged with red from the oxidized iron. It floats on water, in which it is almost insoluble, and small fragments rotate rapidly when floated on this liquid. It burns with a yellow smoky flame, leaving no residue, and volatilizes readily at the ordinary temperature. It is easily soluble in alcohol, ether, and chloroform, and is precipitated from the former in white flocculent masses, when the solution is poured into water. It sublimes readily, and has an odour of camphor, but not so powerful as ordinary camphor from old wood. Its specific gravity is .987; it melts at 175° C., (347° F.) and boils at 205° C. (400° F.). It dissolves readily in nitric acid, with some development of heat, and immediate separation of the solution into two layers, the upper of a red colour and the lower pale-yellow or colourless. The addition of water precipitates the camphor as a white mass from the upper layer of the solution apparently unchanged.

SUBLIMATION EXPERIMENTS.

These were conducted at varying temperatures and under different conditions in order to try and obtain the translucent state common to commercial camphor. The most successful method was by mixing the crude camphor with slaked lime in the proportion of 40 to 1, and subjecting this in a closed vessel to a low heat for twelve hours, the heat being gradually increased up the sides of the vessel in order to drive all the camphor into the upper portion. Copper vessels are the best for the purpose, as glass is liable to fracture from condensed moisture running down to the heated sides.

Before sublimation can be effected, it is essential that all the camphor-oil should be expressed from the camphor. The camphor when first distilled appears to be practically free from oil, but after standing some days oil gradually separates and sinks to the bottom of the mass of crystals, and this appears to

continue for months. Filtration with the aid of a vacuum effects a partial separation, but in practice on a large scale it would be best effected by means of a centrifugal machine similar to that employed for the separation of crystalline sugar from molasses.

OIL.

The oil obtained with the camphor from the leaves is of a clear, yellow colour, having a specific gravity at 80° F. of .9662. It contains a certain amount of camphor in solution, which can be separated to some extent by cooling to 10° C. It would therefore be advisable to cool the mixture of camphor and oil, as much as possible, before submitting it to centrifugal expression.

The root oil, of which 1.22 per cent. was obtained from the air-dried roots, was almost colourless, and had no smell of camphor. It consisted of a mixture of two oils, one lighter and one heavier than water, the specific gravity of the mixed oils being 1.058 at 80° F.

YIELD AND PROSPECTS.

The figures above given show that the yield varies a good deal, but that on the average about .75 to 1 per cent. of camphor may be expected from the young leaves and twigs, as well as a small quantity of camphor-oil, which also has a market value. Samples of camphor mixed with the oil were valued lately at Rs.126 per cwt. If we assume that clippings will yield about 1 per cent. of camphor and oil worth Re.1 per pound, we should be well within the mark. The cost of obtaining this should be about Rs.53 per acre, made up as follows:—

	Rs.	a.
Pruning 1210 trees and carrying to factory	...	37 0
Distilling, fuel, packing, &c.	...	16 0
		<hr/> 53 0

That is, camphor can be put on the market as cheaply as tea per pound if the yield be at the rate of 177lb. per acre (cost of tea being estimated at 30 cents). Now 177lb. will be yielded by 17,700lb. of clippings. In the case of bushes 6 feet apart this means 14½lb. per bush per annum, or about seven times the weight of flush obtained from a prosperous tea bush. On the other hand, the bushes are only half as many to the acre, and the plucking is much coarser, so that this estimate is not unreasonable, and the product is more valuable than tea. It seems not unreasonable to expect that where a bush, with 36 square feet of space to grow in, yields 12 to 15lb. of clippings a year, the cultivation will prove remunerative—not a bonanza, but yielding a fair profit. In the Hakgala Garden this yield is exceeded so far as rough experiments show.

M. KELWAY BAMBER,
Government Chemist.

J. C. WILLIS,
Director, Royal Botanic Gardens.

} In Royal Botanic
Gardens, Ceylon,
Circular No. 24 of
November 1901.

VI. EXTRACTS, NOTES AND QUERIES.

Forests and Climate.

TRIPOLI was formerly a land of crops and woods. Now it is a desert containing ruins of the Punic and Roman periods. M. Mehier de Monthuisieulx, after traversing deserts of moving sand and awful stony roads, has visited Jebel Iffren, a mountain rich in traces of the Roman occupation, otherwise poor indeed — *not a tree, not a blade of grass*. The principal ruins are those of the ancient town of Sabratha, and those of Leptis Magna, the old Punic and Roman capital. These ruins show the former importance of the great emporium. The dead cities, formerly superb, are now humbled beneath the sands of the desert. During the Punic era the sands were not given to wandering, the earth was teeming with vegetable life. More in the interior may be found interesting remains of the old Roman towns on the plateau of Torouhna; these contain numerous constructions somewhat in the form of a portico, and with considerable certainty may be described as oil factories. The country was formerly covered with olive trees: Tripoli was one of the great granaries of the Roman Empire, an abundant source of corn, of oil, and of wine.

"To-day the whole region has become sterile, because of the disappearance of the great forests in the interior which held up the water and distributed it by the river-full." At present this former granary of Europe contains a miserable and scattered population, living or starving, on a few lean patches of barley or alfalfa. M. Mehier thinks that the rest of Tripoli will soon be in the same state as Sabratha, Leptis, Oca, and the rest, for without forests water disappears, and without water man disappears. *From an article by ROGER DUCAMP, Head of the Cochinchina Forest Department, in the "Revue des Eaux et Forêts."*

His Majesty's Woods, Forests, and Land Revenues.

A REMARKABLE INCREASE.

THE annual report of the Commissioners of His Majesty's Woods, Forests, and Land Revenues is issued to-day, and is of exceptional interest. It gives a sketch of the changes that have taken place in the administration of the office since 1832; and it then states that the system under which the land revenues are now managed was inaugurated by the Act 14 and 15 Vict., c. 42 (1851), and, as it differs materially from that under which they were previously managed, the following observations are confined to the period (50 years) that has since elapsed. The hereditary possessions of the Crown in 1851 were widely dispersed, and, in England, there were few counties that did not contain detached and outlying parcels of land, which, from being intermixed with,

and in some cases surrounded by, the estates of private individuals, were more valuable to the adjoining owners than to the Crown. In some instances, blocks of land of considerable extent, belonging to the Crown, possessed, to adjoining owners, an accommodation value. In other parts of the United Kingdom the Crown revenues were largely derived from fixed rents charged on, or from interests in, or rights affecting, properties belonging to private owners. It was consequently decided, as opportunities offered, to sell such properties or rights, provided the full value could be obtained, and to re-invest the consideration moneys in the purchase of other land adjacent to more extensive Crown estates, or of estates large in themselves, and thus, by consolidating the Crown estates, to diminish the cost of management. Copyholds have also been enfranchised, and manors and quit and fee farm rents have been sold. The amount realised by these sales and enfranchisements between the 31st of March 1852, and the 31st of March 1901, was £4,212,925. During the same period a total sum of £4,581,506 has been invested in the purchase of estates, houses, and premises, and in the redemption of charges.

INVESTMENTS IN LONDON GROUND-RENTS.

Since 1873 ground-rents secured upon high class houses and buildings in London have been purchased to a considerable extent as investments for capital moneys, and out of the moneys invested in purchasing estates, &c., a total sum of about £1,982,336 has been expended in buying ground-rents, while further sums amounting to about £326,362 have, since the same date, been invested in the purchase of other house property in London. The ground-rents so purchased amounted to £75,909 per annum, and the rental obtained for the houses, &c., purchased, and let otherwise than at ground-rents amounted to £12,682 per annum. The investment of about £2,308,698 has, therefore, produced an average return of nearly £4 per cent., and, in addition to this, the capital values of the properties acquired have now very largely increased.

EXTENT OF THE FORESTS.

The net income of the land revenue between 1851 and 1901 showed an increase of £205,265 a year; the revenue having been £259,178 in March 1852, and £464,443 in March last. Excluding the land belonging to individuals over which the Crown possesses no rights whatever, or merely a bare forestal right, the Royal forests and woodlands, exclusive of Windsor, extend to about 98,000 acres. Of that quantity a little less than one-sixth part, or about 17,000 acres, belong to the Crown absolutely, free from any rights of common. The whole of these 17,000 acres are planted or otherwise occupied. Upon the remaining five-sixths, which are subject, when unenclosed, to rights of common by a

numerous body of persons, there are in the open forests about 23,000 acres covered with timber or trees, and there are about 18,000 acres of growing timber and trees, which have been planted in enclosures, under the provisions of various Acts, by which the Crown is empowered to enclose and plant certain limited quantities of the commonable land, and to keep them enclosed as long as may seem desirable.

PRESENT RESULTS AND FUTURE PROSPECTS.

The report concludes with the following statement of results:—

1. That the total sum paid into the Exchequer during the reign of Her late Majesty on account of the surplus profits of the land revenues amounted to £20,146,575.

2. That since the separation of the Office of Woods from that of Works, in 1851, the Commissioners of Woods have realised, by the sale of property that it was not desirable for the Crown to retain, and from enfranchisements, about £4,212,925, and have invested £4,448,167 in the purchase of other estates or properties, of which a sum of £2,308,698 has been invested in the purchase of ground-rents and other properties in London, at an average return of about £4 per cent. per annum.

3. That in the past year the net income was 79 per cent. greater than in 1851-2.

4. That the agency, local management, and collection of the revenue (£555,257) from the landed estates, exclusive of Windsor Park and the Royal Forests, cost only about 2½ per cent.

5. That, notwithstanding the very large increase in the income of the land revenues, the cost of the Office of Woods including the Land Revenue Record Office, remains practically the same now as in 1852-3.

We have hitherto confined ourselves, the Commissioners add, to dealing with accomplished facts, and there is some difficulty in attempting to forecast the future. We think, however, we may safely add that, if the system of management which has prevailed in the past fifty years be adhered to in the future, the income of the land revenue may be expected to continuously increase for many years, and that at no very distant date, and probably within the next quarter of the century, the increase will be considerable. —(*The Globe*.)

THE INDIAN FORESTER.

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[No. 5

A Sojourn in the Rukh.

By Z.

ENDLESS is the variety of India, and few indeed are they who can claim acquaintance with all its faces. There is what may be called conventional India, the "India of the picture books," where the lordly elephant crashes through the primeval forest, where the tiger nightly sallies forth to seek his prey from the village hidden amidst the towering palms and spreading banyans of the jungle, where birds of strange and dazzling plumage fly afar in the golden sunshine or lie hidden in the umbrageous depths of giant trees, where a timid and all but naked people lives the year round in steamy tropical heat. There is "India's coral strand" (with many of us our first conception of the immemorial East), where the poor heathen stands on a low surf-beaten shore with a background of cocoanut palms, smoking funeral pyres and cars of Juggernaut. There is "the gorgeous East," a vague and fascinating image, consisting chiefly of bejewelled rajas seated on elephants caparisoned in cloth of gold in the courtyard of some marble palace, from the trellised lattices of which peep the full dark eyes of Oriental beauties. These are not entirely pictures of fancy even yet. They have their reflex in reality—pale, perhaps, and even tawdry compared with the rich colours with which imagination generously limns them. You may see your tropical jungle in Lower Bengal; and a voyage down the southern coasts will show you here and there the coral strand, though without all the accessories of one's youthful fancy; many of the native States still on occasion make a brave show of Eastern pomp and chivalry. But how many more aspects has India to show to the industrious traveller! and industrious in truth must be the man who would see them all. The globe-trotter who moves by easy stages from Bombay to Jeypore, from Jeypore to Agra and Delhi, and thence down through the Gangetic plain to Calcutta, returns home flushed with the achievement of having "done" India.

The ordinary Anglo-Indian who spends his cold weather in a provincial capital or in some military cantonment and his summers in an isolated hill station, thinks he knows all that is worth knowing about India. Yet neither of them know very much even of the physical surface of the country. The present writer knows less perhaps than most people who have spent any time in India, and he cannot presume to reproach others for their lack of enterprise. But these reflections are pardonable in one who, scorning the beaten track, has devoted a part of his precious leave to a sojourn in the Punjab *rukhs*, the dry jungle that abounds in that part of India wherever water fails.

The *bar* land, that is the desert country between two rivers, is one of India's many faces, and at first sight one of her least attractive. The train journey, say, from Lahore to Mooltan, is depressing in its ugliness and monotony. For mile upon mile you pass through a country that seems too arid to support anything but scrub and stunted trees, which stretch away unbroken to the horizon. Here and there are small patches of cultivation, where the crops are only kept alive by constant irrigation from wells sunk sixty or seventy feet below the surface. But the fresh green of the growing crops only emphasises the surrounding barrenness. It is a dreary picture, and one wonders how such a country can support villages full of people, cattle, camels, goats and sheep; whether they live well or ill, the inhabitants surely cannot know much joy in life. It seems impossible to associate cheerfulness with life in a land so flat, so brown, and so sterile. These are the reflections that occur as you speed through the desolate *bar* country in the mail train. But a few days' close acquaintance with these deserts causes you to revise your impressions. It is said that the vast and expressionless veldt of South Africa has a strange fascination for those who know it well, even though they be native to smiling English valleys. I can easily believe it after having seen the Punjab *rukhs* at close quarters. What seems from the railway carriage window a wilderness of shabby trees and disreputable scrub, becomes after all a country with a certain grace of its own. The still air, the quiet skies, the wealth of sunshine, and the all-pervading silence seem to be manifestations of a *genius loci* whose influence is soothing and, yes, cheerful! We speak of smiling and frowning landscapes, of Nature rioting in tropical luxuriance, or laughing in the well-ordered plenty of cornfields and vineyards. But how do we describe her quieter mood in which we find her in these desert solitudes? No single word seems quite apt to convey the impression. There is not much obvious beauty and perhaps little majesty in these sparse and silent forests. Still these qualities are not entirely absent. The seeing eye may discover them in the vastness of the landscape, the clear atmosphere, the brilliant light and the patient trees. The complacent railway traveller may spare his pity for the joyless lives of the children of

the *rukhs*. Simple, ignorant, and ugly they are, but when you see them in their own environment you cease to wonder how they can support its plainness and monotony. They know nothing better indeed, still they might know something much worse; and it would be a nice question to decide which is the happier lot—that of the goatherd carolling his evening song as he drives his flocks from the forest pastures, the *sirwan* sleepily watching his camels grazing off the salvadora and farash shrubs of the *rukhs*, or the lot of the Lancashire operative who never sees a clear sky or breathes air that is not smoke laden, and to whom the charm of silence and solitude never comes.

I spoke just now of the patient trees. No one who has seen the *rukhs* and caught some glimpses of its spirit will cavil at the description. Patience is the pervading essence of these desert forests. Nature here has little wealth to dower upon her offspring. Below, a hard and unwilling soil where even the earth-worm cannot make a living, above, an all-but rainless sky. Yet from this sterile *putt*, as this kind of soil is called, spring innumerable dwarf trees of a few hardy kinds, while the camel-thorn (which the camel will not touch) flourishes in ragged clumps on every hand. Day after day the sun makes his passage across the unclouded vault, and nightly tinges the west with faint and momentary fires. Showers in these parts are events, like snowstorms in the south of France. Children of six and seven years old may never have seen rain, and even clouds are noteworthy phenomena. Barren, hot and waterless as the land is, it is nevertheless not bare; but the vegetation which abounds is of the poorest and the most hardy—not hardy like the sturdy trees of bleak northern climes, where constant battle with storm and frost gives them a heroic and somewhat defiant air, but with the hardihood of poverty borne without stress and without complaint. Poor as they are, these trees of the *rukhs* have to support innumerable creatures. Grey partridge, sand-grouse, parrots, and a host of smaller birds find a home in their branches; while rats, squirrels, hares, foxes, and jackals burrow amongst their roots. They give shade and food to herds of wild buck; camels, goats, and even cattle graze upon their foliage, and in the end they are felled to provide the sole fuel-supply of a province larger than Great Britain.

For all this variety of animal life the trees, stunted, dusty, and unimposing, are veritably the staff of life. Here and there in the *rukhs* occur wide stretches of naked waste, covered perhaps with the debris of ancient brick-kilns, or blighted by some natural cause. Here you have the desolation of desolation. With the cessation of forest, the birds, the wild buck, the hare and the jackal are no more, not even a blade of grass or a solitary weed can find sustenance amongst these sterile mounds or upon these wide flats of *putt*, acrofulous with white patches of saltpetre. These great gaps in the *rukhs* bring home the fact that the little trees are the life of the

country. Without them the whole *bar* would be a dead and empty waste. Small and shabby they may be, boasting no beauty except when the setting sun bathes their dry foliage in a flood of gold and amber. Still the wilderness and the solitary place are made glad by them; they heal the leprosy of the soil by absorbing its strong salts, and they give food, shelter and warmth to beasts, birds, and men, who without them must flee to more hospitable land. Of all the inhabitants of the *ruk*h man alone systematically preys upon the trees. He brings his herds to eat off the tender shoots and trample down the saplings. He clears great spaces for a few years' cultivation of the soil, and when the overworked well gives out or falls in he removes to repeat his work elsewhere, leaving nothing to replace the trees that he has felled. Worse still, he ruthlessly cuts down the forest for fuel, and makes no provision for the protection of the young shoots that will spring from the stumps left in the ground. This denudation of the forests proceeds all over India; despite the vigilance of the Forest Department. Fires are deliberately started to clear the ground for grazing, and in this way acres of valuable timber are consumed for the sake of feeding perhaps a few head of cattle. Large areas of the hill-sides of the Himalayas have thus been stripped of their trees, with the result that in the monsoon the rains sweep down into the submontane tracts and frequently cause great destruction of crops by flood. It is certain moreover that the deforestation of large parts of Northern India has seriously affected the rainfall of the whole country, and the famines of recent years are in a measure the penalty now being paid for the squandering of forest wealth by previous generations. This digression may be pardoned when it is understood that the work of the Forest Department throughout India is overtaking the extravagance of the past is of importance even in the dry *ruk*hs of the Punjab. Here the timber is fit for nothing but fuel, but as fuel it is extremely valuable in a province which has no indigenous coal supply worth mention. Consequently large areas of the *ruk*h are preserved by the Department. Grazing is restricted or altogether prohibited, and felling is conducted systematically. When a section is cut for fuel it is then closed and left untouched for a few years, so that the trees may have a fair chance to spring up again.

It is in these Forest Reserves that one comes to closest quarters with the spirit of the *ruk*h. Silence, solitude, and sunshine—these are common to nearly all parts of these waterless jungles. But in a closed reserve the solitude is even more profound. The soft pad-pad of your camel as he carries you at a swift trot through the deserted aisles of the forest is the only sound. The sudden whirr of a partridge as it rises almost under your camel's feet makes you start as though it were the explosion of a gun. Presently a *chinkara* buck, the prettiest creature that the *ruk*h can show, appears a hundred yards or so away grazing on the trees.

This offers a chance of a shot, so you stop the camel, and with soft cries of "hooshk" "hooshk" prevail upon it to sit down. But few camels will sit down without grumbling, even at the end of a journey. No wonder then that the brute raises an outcry at this unnecessary and unreasonable stoppage. He begins to hubble-bubble, as it is called, emitting a sound which can only be described as a peevish complaint in *basso profundo*—a series of short and rapid grunts producing the effect of water being poured from a bottle (hence "hubble-bubble") varied with a longer note, half groan and half roar. After such a salvo, which must have been heard for a mile at least in this clear and soundless air, your chances of getting another sight of the buck are of the slightest. The *chinkara* buck is the embodiment of caution and timidity. About half the size of the English fallow deer, he is twice as wild and equally swift. The sound of voices a mile off will put him on the alert; the snap of a dry twig will send a whole herd bounding away for a league or more. The sight of a camel may not alarm them, but the meaning of that hubble-bubble is not to be mistaken. Camels are not stopped in the midst of the forest for nothing, and the buck know only too well that that loud grumble is likely to be followed by the crack of a rifle and the singing of a bullet. Nevertheless, you leave the camel in charge of your native guide and venture cautiously amongst the surrounding trees. The first buck may have been only the advance guard of a large herd returning from water or moving to a new grazing ground. So you step forward on tip-toe, keeping your eyes skinned, as the soldiers say, and eagerly peering down the long irregular avenues that open out ahead and on all sides as you move along. As in the mountains, where you are ever apt to imagine that the peak or the ridge just in front of you must be the summit of the range, a towering Pisgah from which you may view the Promised Land on the other side, so in this thinly timbered but extensive *rukh* you are tempted to believe that every fresh opening will give you a longer and wider view—the impression will cling to you that just beyond that line of trees (a line, need I say, more imaginary than any in all the books of Euclid); there is an open space where you will be able to reconnoitre your position and perhaps lie in wait with a good chance of sighting a grazing buck. This, despite your certain knowledge that the forest extends for hundreds of acres in all directions. The line, of course, recedes as you go on, and the openings grow neither wider nor longer. There is nothing for it, then, but to wait, and so you sit down on the dry *putt* with the rifle ready to come up to the shoulder at the first opportunity of a shot. Now for the first time you begin to feel the silence of the forest. Not a leaf stirs, not a bird twitters, not a sound but the ticking of the watch in your pocket. There is a strange solemnity about this profound quietude here in the open under the blazing mid-day sun, but a solemnity that is restful and soothing rather than

oppressive. I have been in virgin forest in the tropics where also the silence is remarkable, but there is always a low hum of insects to remind you that life in infinite variety turns all round you. This stealthy hush amid the half-light of the swarming "bush" is oppressive and uncanny. But here in the sunny *ruk* there is no undertone to accentuate the stillness. Not even the distant lowing of cattle or the faint tinkle of a wether-bell penetrates so far into the wilderness. The quietude is complete. It is the silence of emptiness, such silence as we may suppose pervades the heart of Nirvana.

It is clearly the wrong time for buck or game of any kind. Morning, when all the creatures of the forest are stirring for food and drink, is the opportunity of the sportsman. It is a marvel, by the way, where they all go for water. Buck may and do travel enormous distances for it, but these birds and the creatures of the ground—where do they go to slake their thirst? The natives say that the rats and squirrels never drink, but the foxes, jackals, and hares must find water somewhere—probably from the irrigated fields of the villages, for in these parts there are no *jheels*, and even the rivers are almost dried up in the absence of winter rains. Water, if it could be brought in sufficient quantities, would change the whole character of this arid *bar* land. This has already been accomplished in the Jhang *bar*, where two great canal systems for the utilisation of the waters of the Jhelum and the Chenab have been constructed. In this way over two million acres of desolate wilderness have been turned into rich arable country, dotted all over with thriving villages of settlers drawn from the more crowded parts of the province. Whether the same can be done for the *bar* between the Sutlej and the Ravi is a moot question. The Forest Officer will tell you that by these irrigation schemes the Government is sacrificing the fuel-supply of the province; while the officers employed in collecting and enumerating camel for military transport will be equally emphatic in denouncing this policy of wholesale canalisation. Camels do not flourish in irrigated country. Deprived of the dry soil and the dry air of the desert they gradually die off. There is nothing like leather, and the forest man and the camel enumerator are no doubt entitled to a respectful hearing. At the same time the policy which has turned such large areas of sterile *ruk* into gardens of plenty is abundantly justified by its results.

But apart from the practical aspect of the question, one cannot but feel a twinge of regret at the thought that some day, probably not far off, these quiet forests will be stripped for the plough, the solitude will be invaded by thousands of busy cultivators, and the spirit of the *ruk* will have departed for ever.

V.—SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

BY F. FINN, B.A., F.Z.S.

CHAPTER I.—INTRODUCTION.

Taken as a whole, no family of birds is of such general utility to mankind as the *Phasianidæ*, belonging to the order of game-birds, the *Gallinæ* (hens) or *Rasores* (scratchers) of scientists. No less than four species—the fowl, guinea-fowl, turkey and peacock—are domesticated in the full sense of the word, while several species of pheasants are reared artificially either as ornaments or for sport. In India these birds are of especial importance; the country contains an unusual variety of species and genera, and the sport they at present yield could be much improved by better protection given to the birds. For none need assistance in the struggle for existence more than game-birds do; other animals appreciate their flesh as well as man, and their habit of breeding on the ground renders them peculiarly liable to fall a prey to terrestrial vermin. Moreover, their limited powers of flight render it impossible for them to range far and wide in times of famine, and hence they are liable to perish from want just as beasts do. On the other hand, their speed of foot and habit of frequenting cover secures them to a great extent against birds of prey; and their resident and omnivorous habits

render it easy for man to encourage them to any extent by means of artificial feeding. Thus, on the whole, they are easy birds to cultivate, and the encouragement of a good stock should be one of the chief studies of every forest officer. For not only are the birds useful for food and as affording a healthy recreation, but they are of service in a forest by destroying many noxious insects and by turning over the leaves and surface-soil in their search for this and other food. In addition to insects, some will eat mice and young snakes, so that they are good general vermin-destroyers; and though they devour much seed and grain, their own utility as food secures their being kept from increasing to such an extent as to be a pest themselves.

There is another aspect from which game-birds are worthy of attention from a utilitarian point of view. They carry, as a family, far the most beautiful plumage of any group of birds; I speak after examining many specimens dead, and a few alive, of the long-celebrated Birds of Paradise. Not only the peacocks but several of the pheasants far excel all of these both in general brilliancy and in the individual plumes which go to make up their splendour; while the tiny humming-birds can never enter into competition with such large species as are the pheasants and their kin. Now, as humanity has always been constant to feathers as a means of decoration, it seems to me that the systematic cultivation of the more brilliant game-birds as plume-producers would pay very well; such cultivation has been profitable in the case of the ostrich, where it entails much more trouble and expense, to say nothing of positive danger.

The outcry which has long been raised against the wearing of feathers is only just when this custom results in the reckless and cruel killing-down of a species to its vanishing-point by greedy dealers and their agents; there is no harm whatever in wearing feathers legitimately obtained, *i. e.*, by taking them from birds killed for food or reared for the purpose of being shorn as is the ostrich. It seems to me therefore that in the protective cultivation of game-birds for food, sport, and feathers there are the germs of very considerable profit, to say nothing of their above-mentioned utility as pest-exterminators.

Better than all, in my own private opinion, is the importance of game-birds as an adjunct to scenery. Although less imposing than the birds of flight, the graceful form and conspicuous size and colours of many of the larger species make them some of the best of ornamental birds; indeed, the peacock is the oldest "fancy" bird known, and is still admired where the cultivation of domestic monstrosities has not sufficiently corrupted public taste. And if it has been worthwhile for humanity all these centuries to foster a bird which, admittedly, has many faults, for its beauty alone, we may surely plead for an extension of protection to all our finest species, even if they had not solid qualities to recommend them.

Having said this much in attempted justification of game-birds as a subject for study by the most practically-minded, I may proceed to the characteristics of the family, all of which may be easily verified on the first chicken that comes to hand.

The head is notably small for the size of the bird, with a small beak, short and stout, with the upper outline arched; the nostrils are half roofed over on the inner side by a gristly scale; the mouth is wide, running back nearly below the front of the eye, (N.B.—The beak is to be measured from this point, called the *gape*, to the tip). The neck is long and the body stout and heavy; the wings are short, concave, and rounded, the pinion quills or flight-feathers not projecting noticeably in repose in any species; the legs are powerful, the shanks stout and covered in front with a double row of large scales meeting in a zig-zag seam; the toes are four in number, three spreading ones in front, united at the base by a short web, and a much smaller one behind, set on at a higher level than the rest. The tail varies very much; in the fowl and many other species it is vertically folded in repose, but it is often flat like any ordinary bird's.

Internally, the birds of this family are noteworthy for their large crop or food receptacle in the gullet, and powerful gizzard or grinding-stomach; their breast-bone is also remarkable, being so deeply cut into at each side by two great notches that hardly any of the body of the bone is left, and it presents, when cleaned, the appearance of a narrow central portion bearing the deep keel, and a somewhat V-shaped projection on each side.

The *Phasianidae* are as uniform in their habits as in their structure, the common fowl being a fair type of all. They are not all polygamous like him, nor do they all roost on a perch in the same way. Neither are all of them provided with spurs—a weapon, by the way, confined to this family. But all feed on what they can get—seeds, green-food or small animal life; all trust to their legs before their wings, and fly violently rather than strongly, generally with alternate flappings and sailings; and all rigorously avoid bathing, choosing instead to roll in sand or dust to rid themselves of dirt and vermin. They are very enduring of cold, three out of the four domestic species being from a hot climate, and yet bearing the English winter well; but those which inhabit temperate regions are generally very intolerant of heat. Our hill pheasants, for instance, cannot bear the hot weather in the plains. All the species usually nest on the ground and lay pale eggs.

The young of these birds, as everyone knows, can run soon after birth; they are clothed in soft down marked with brown and buff stripes. In their first feathering they most resemble the old hen, but may be known by their pointed quills. So, if none but cocks showing the full feathering are shot, one is sure of plenty of hens and young cocks to carry on the breed, and thus any number of males may be secured for food or feathers with no

deterioration to the stock, but rather to its advantage ; for in these so often polygamous birds a large proportion of males is a distinct disadvantage for breeding, as one is often sufficient for several females, and a larger number means much domestic discord.

In dealing with the various genera and species in detail, I shall follow the scientific nomenclature employed in Dr. Blanford's fourth volume on the Birds in the Fauna of British India series. I shall also adopt the genera therein employed ; and it is a great help to the beginner in ornithology that the said genera or groups of species in the game-birds are so well defined, as will be seen later on. Some of them are, indeed, recognized by popular names :—thus, we speak of the "peafowl" and "jungle-fowl" for the species of *Pavo* and *Gallus* respectively. But under the general names of pheasants, partridges, and quails, several very distinct genera are classed in each case. However, it seems best in a work intended for beginners to maintain these popular distinctions, if only for the sake of convenience.

To commence, then, with the most familiar birds of all :—The *jungle-fowl* are distinguished by their combs, fleshy ridges of skin running from the base of the beak up the forehead ; these are very small in the hens, but always discernible, and at once mark off all our three species of jungle-fowl.

The *peafowl* are at once separable by their crest and great size ; the shank is five inches long or over, none of the other members of the family having it as much as five inches. The cock Argus comes nearest, but he has a very different tail and no crest.

The *quails*, on the contrary, are very little creatures, the largest quail having a closed wing of under five inches, whereas all birds with a wing over this length may be reckoned as partridges, it being understood that the term merely refers to size.

The real difficulty lies in separating the partridges and pheasants, which make up the bulk of the family.

Pheasants are generally large birds (never under eighteen inches long), with the tail as long as the wing or longer ; when it is shorter, the difference is not more than two inches, and it only reaches this in the Tragopans and Monauls.

Partridges are almost always much smaller than pheasants, with proportionately much shorter tails ; in one partridge, the bamboo-partridge, the tail is longer than the wing, but by much less than two inches, while the bird is much less than eighteen inches long ; two partridges, the snow-cocks, are bigger than many pheasants, but they have the true partridge short tail, about three inches less than the wing.

The smallest members of this family have the widest distribution, partridges and quails being found almost everywhere, the latter being especially widely-spread. The pheasants, except where artificially introduced, do not occur outside of the continent

of Asia as a rule, one species only, the common or Colchian pheasant, occurring in Europe. The peafowl and jungle-fowl are confined to the warm regions of South-eastern Asia. Africa is held by the guinea-fowls, and North and Central America by the turkeys.

The boundaries between the different species and genera are settled by the right of the strongest; at any rate, in England it has been found impossible to have guinea-fowls, or golden or silver pheasants wild along with common pheasants, since the last are not able to hold their own with these birds. When two closely-allied species of *Phasianidæ* meet they interbreed and fuse, and what with this hybridism, and the tendency of some species to throw off sports, or "aberrations," as students of butterflies would call them, the family is a remarkably interesting one, as it undoubtedly shows better than any other the methods of evolution still actively in progress,

(To be continued.)

VI.—EXTRACT NOTES AND QUERIES.

Note on the Life History of the Tasar Silk Worm.

In the Bhandara district of the Central Provinces there are in one year generally three crops of tasar cocoons. The first crop is known as the "Bhadolya," the second one is known as "Diwalya" and the third is known as "Kathanya" or winter crop. The last two are invariably taken, and sometimes all three. A fourth crop would have been possible if the saj or yen leaves (*Terminalia tomentosa*) did not become rough or did not begin to fall and the season were to remain mild. It is said by some Dhimars near Bhandara that a fourth crop is taken by those Dhimars or Basors who live in the zamindaris in the south-east of the district. But it is difficult to believe their statement, as the saj tree is not an evergreen.

The usual custom in this district for the Dhimars engaged in sericulture is to secure a good number of wild cocoons known as *ranat*, which are collected by the cowherds or graziers in the hot weather when the forests are leafless. They are generally found in the forest on yen, ber, dhaora or lendya trees. The graziers sell them to the Dhimars, who cultivate "tasar badies," at from 50 to 200 cocoons per rupee for purposes of seed. When a khandi or half a khandi (two thousand cocoons go to a khandi) are secured, the cocoons are brought home about the end of May and kept in a basket in a cool place to protect the pupa from excessive heat, which would kill it. At the first burst of the rains, some time in the month of June generally, they are sorted into clusters and tied to posts driven into the ground in a sheltered locality outside the house, generally under the eaves. Cultivators whose homes are far from the forests tie the cocoons to mango or mohwa trees near the forest and visit them every day. A green branch of lendya or saj is also tied to the post along with the cocoon clusters, to serve as a

support to the moth when it comes out. The perfect insect comes out during the night from a hole made in the cocoon close to the stalk by which it is suspended. If the emerging insect is a female, it remains on the same branch; but if it is a male it flies away at once in search of females. It is always said and believed that the male insects that come out of these cocoons are not of so much use to the female insects of the cultivators' collection as the wild males. I was informed that the wild moth is of most use in propagation, and hence a good deal of discretion is required to be exercised at the time seed cocoons are purchased. As far as possible, large, elongated and hard cocoons are selected, as they generally produce female moths, on which the future success of the cultivator is based. Two-thirds of female cocoons and one third of male cocoons are purchased. Naturally, disappointment sometimes awaits the purchaser, as many supposed female cocoons turn out to be of the other sex and *vice versa*. As a rule the female moth has a larger body than the male, and this is perhaps the reason why the female is unable to fly about, whereas the male has a tendency to disappear or take to the neighbouring forests in search of a mate. The male fertilises the female during the night, more specially towards the latter part of it. He remains with the female until separated by the cultivator towards the evening of the next day. If left to himself he would probably fly away, and hence the male is secured by a thread and kept in custody till the night comes on, when he is again used in covering another female. At the most one male can serve three females, after which he dies, as these moths, whether male or female, do not live for more than 4 to 5 days. Fertilisation by a wild male is considered more desirable than that effected by one that has been reared by man. Many females die without being fertilised. As soon as the male is separated from a female, the latter is removed and kept in a basket, where she will have laid almost all her eggs by the next morning, though she may give a few next day also. Some cultivators take eggs from the females one or two hours after the separation of the male by shaking her body. All the eggs are laid by the insect in two operations, or at the most three, after which the female dies. Each day's eggs are kept separately in different lots tied up generally in a thin white cloth. These lots are then kept in an earthen pot to keep the eggs warm. The larvæ break the egg and come out in 8 to 12 days, the time depending solely on the state of the atmosphere; if the air is warm less time is required, if otherwise a longer time is required. As soon as the larvæ begin to come out, they are put into a conical cup made of the char leaf (*Buchanania latifolia*), which is taken to the forest and fastened to the leaves of the yen tree. The reason for selecting the char leaf is said to be that being thick, it retains a certain amount of warmth for the eggs, which enables the larvæ to hatch out quickly, otherwise cold may either delay the hatching of the remaining eggs or kill the insects before they begin eating. They then

spread over the tree and begin to feed. If there is any delay in taking them to the forest, they begin to eat the egg shell from which they come out, or even the cloth in which they were wrapped up; hence the precaution is taken to keep every day's eggs in separate lots so that no mistake can occur in transferring them from the home to the forest as each lot becomes ready. On each saj tree 3 or 4 char cups are fastened. The saj trees are always pollarded and kept at such a height that any branch may be easily reached from the ground so as to enable the cultivator to lay hold of the larvæ while feeding and take them to another plant when the leaves of the first plant are consumed. Moreover, their protection from insectivorous birds becomes more easy. The larvæ feed on the leaves for from 4 to 6 days, depending on the season, after which they remain quiescent without eating anything for about 24 hours to sometimes 4 days, preparatory to moulting. The actual moulting takes a very short time, hardly more than 8 to 10 minutes if undisturbed. It is preceded by a backward and forward movement of the body, and at once the head covering separates and falls off, then the larva comes out on a leaf nerve or on a small twig. When he has fully emerged the cast off skin remains behind him stuck to the leaf or twig, and he occupies himself in cleaning his body, especially the hindmost part, by his mouth; he then remains quiet for an hour or so, and when he begins to move the first thing he does is to turn right round, and applying his mouth to the cast-off skin he begins to devour it from one end to the other; this takes about 15 to 18 minutes to finish if left undisturbed; if touched he stops for some time. After the skin is devoured he begins to crawl about and eat leaves and feeds on them voraciously for about the same period, viz., 4 to 6 days, and again sits quiet as said above. The cultivators informed me that this eating of the cast-off skin sharpens their appetite and also keeps them free from diseases to which they are liable. If an insect fails to do this, he is bound to die after a few days. He soon begins to become pale green, then yellow and emaciated, and in the end succumbs.

The process of feeding and casting off the skin is repeated four times, though the last time requires a day or two longer for both the processes. After the last stage is gone through 10 to 20 days are spent by the larvæ in feeding with great vigour, by which time he grows to a size as thick as a man's thumb and about 2 inches in length. He then sets about spinning his cocoon in the following manner.

Joining one or more leaves together for a support, he spins the bottom of the cocoon first and proceeds upwards towards the stalk, which he attaches to some twig or other. After the stalk is finished he comes down and enters the hole, which was kept open at the base of the stalk and closes, that hole over him. All this he finishes during one night. Next day he is seen working

inside the cocoon through the meshes of the net. While he is lining the inside with silk threads from his mouth, he secretes a kind of gummy or sticky substance from the abdomen. This secretion exudes through the meshes and the cocoon becomes hard and opaque. In three days he completes the whole thing, and then sleeps to come out again as the perfect insect or imago. The secretion is either yellow or white, hence some cocoons are yellow and some are white. The colour has nothing to do with the quality of the cocoons. The cocoons are then allowed to remain hanging to the tree for 2 or 3 days in order to dry. When dry they are collected, sorted into qualities, and stored until purchasers come. They are generally of three kinds. Very hard and large cocoons are classed first, softer ones go into second class, and very soft ones are put into the third class.

The 1st class fetches—Rs.7 for a khandi of 2000.

2nd class Rs.5-8 for a khandi of 2000.

3rd class Rs.4 for a khandi of 2000.

The first or "Bhadolya" crop is always of the second or third quality. The second crop called "Diwalya" gives the best results, whereas the third "Kathanya" again deteriorates into the second quality. The seed required for the first crop is always secured from the wild cocoons collected in the forest by graziers, for the second or third crop the seed cocoons are obtained from the preceding crop. After the third crop is taken the cocoons are said to be of no more use for seed, and hence they are never preserved. The wild seed cocoons collected in the forest are generally spun at the same time of year as the cultivated ones of the "Kathanya" or winter crop, but it is only the wild cocoons which are kept for seed, not the cocoons of the "Kathanya" crop.

The following statement shows the number of days required for each crop and the period of the year with corresponding English months:—

Name of crop, &c.	Days taken by eggs to hatch.	Days of active eating of leaves before moulting.	Days of rest during the period of moulting.	Days of eating leaves after all the four castings of skin.	Days required for spinning and completing cocoons.	Days required for drying the cocoons before collection.	Total number of days.
Bhadolya or 1st crop. Beginning of rains to end of Asadha, 15th or 20th of June to end of July or 1st week of August.	8	17	5	10	3	3	46
Diwalya or 2nd crop. Middle of Sawan to between Dasera and Divali, about 20th of August to about end of October.	10	21	9	16	3	3	62
Kathanya or 3rd crop. Middle of Katik to beginning of Magha, about 15th of November to about end of January.	12	25	13	20	3	3	76

An interval of about 20 days is generally necessary for seed cocoons for producing moths for future crops between the first and second crop and between second and third crop. Thus for about eight months of the year cultivators of the tasar silk worm are engaged in the industry, while during the remaining four months they maintain themselves by fishing. One noteworthy feature about these men is that the headman of each family engaged in sericulture is to observe celibacy. He may neither get himself shaved nor pare off his nails until each crop is harvested.

It has been further discovered that the tasar silk worm is also reared on lendya (*Lagerströmia parviflora*) in this district exactly in the same way as it is reared on saj (*Terminalia tomentosa*), with this difference that only the first two crops are taken on it, as the leaves of the tree get rough or begin to fall soon after December.

B. PARANJPE,
Forest Divisional Officer,
Bhandara Division.

An Unfortunate Incident.

At the beginning of December last year, a party of about 10 native students from the Forest Class of the Poona College of Science were sent to Kanara (Bombay Presidency) to be shown a little practical forestry in the fine teak forests there, under the care of the officer in charge of the Working Plans Division, S. C—, a Parsi Extra-Assistant Conservator of Forests of considerable ability and experience. The students were taken to various places by this officer, and on the 10th December, the camp being then at Kulgi, seven of them accompanied him to a part of the forest where selection fellings had been made two years before in accordance with the working plan in force. On the way back from the forest one of the students, a Brahmin youth of 20 years of age, named Gudi, was suddenly found to be missing from the party, and although search was made for him at once and continued for some days afterwards, nothing has been heard or seen of him since. The disappearance of the student is a mystery, and all kinds of theories have been advanced to account for it, as will now be shown, but no satisfactory explanation can be found.

The circumstances of the visit paid to the forest that day are as follows:—The compartment visited was distant about 6 miles from Kulgi, and the start was made about 7 A.M. on foot, except that the Parsi officer rode his pony. The first part of the way was along a clearly marked cart track through the forest for about 3 miles to a village called Jambga, thence across a number of paddy fields, and then again for about 2 miles more along the cart track in the forest. The compartment to be visited was

then reached, and the party, which now consisted of the Forest Officer, students, two forest guards and two villagers, left the road and entered the forest by a narrow but fairly marked track. The jungle consisted of dense high forest, principally composed of teak mixed with bamboos, and with fairly dense undergrowth of shrubs and grass and small bamboos. The configuration of the ground is very irregular, broken into a series of hills and ridges, with narrow valleys or nullahs and depressions. The path followed lay more or less along a ridge trending upwards, and after proceeding for about a mile, they found it necessary to leave the pony on account of the difficult nature of the ground. The party then proceeded about another quarter of a mile, when they emerged on the top of the north slope of a big gorge at the bottom of which flowed the Kali Nadi about 1,500 feet below them. A fine view of the surrounding forests was obtainable from this place, and the party seated themselves on some rocks and were given a lecture by the Forest Officer on the nature of the forests and of the working plan applied to them. From the place where they were seated the descent to the river, whilst not absolutely precipitous, was very abrupt. There was little fear of any one sustaining more injury than a broken limb by falling over, but even a hardy climber would find it a matter of difficulty to descend to the river safely. It is important to mark this place clearly, as it was at the moment of leaving it to return to camp that Gudi was last seen. There was abundant evidence that Gudi was with the party at this time. Whilst on the ridge he had showed impatience at the lecture and had complained to the boy next to him that he was hungry, having left camp without taking any food. The order to return was given about 11 a.m., and at the moment of starting Gudi's presence was particularly remembered from the fact that he called attention to something being wrong with the Parsi officer's head-gear, which was rectified. Nobody had any recollection, however, of seeing him after the start, and although the party proceeded in Indian file on account of the narrowness of the track, he was not remarked by any one as having been either in front or behind them, and the inference must be that he was at the end of the line. The Parsi officer mounted his pony at the place where it had been left, but no real halt was made here, and the party proceeded as before: a forest guard in front followed by the officer on the pony and students, &c., in Indian file. Apparently they were all hungry and tired and walked forward without talking or taking much note of their surroundings. When they got through the compartment and reached the cart track, which, as already shewn was about a mile from their resting place, the party began to spread out, and one of the students then remarked, "Where's Gudi?" It was then seen that he was not in the party and after shouting to him without getting any response, a guard and villager were first sent back along the way they had come to look

for him, and subsequently the whole party returned, shouting and searching the forest on both sides. The search was continued till about 2-30 p.m., when the party returned to Kulgi, hoping to find that the missing student had after all preceded them there, but nothing had been seen of him. On the next day search parties were organized early in the morning (the villages are few and thinly populated and it is difficult to get many men together quickly), and a thorough search of the forest made in all directions. Not a trace could be found of the missing student, though the search was maintained for three days more. Report of the occurrence had been made to the Conservator of Forests, S. C., who, together with myself, was at Haliyal, about 25 miles away. The annual timber auction of the division was then in progress, and it was impossible for either of us to get away even if by going ourselves to the place any more thorough search could have been instituted, which did not seem likely. The points where the student was last seen and that where he was first found to be missing being only a mile apart, it was thought that news of some kind must soon be forthcoming, and orders to make a thorough search were sent. Days passed, however, without any news being obtained of the man and any hope that he might be alive had to be abandoned. For a short time it did look as if the mystery had been cleared.

The different theories that have been advanced to account for the disappearance of the student are interesting. First there is that of the villagers, which is that the jungle devil known to inhabit these forests has got hold of the lad and is detaining him. Legends are told by them of two similar disappearances in by-gone years, one of a village mirashi, who having lost himself in the forest returned to his village a month afterwards without any recollection of where he had been in the interval, and one of a boy, 8 years old, found after 8 days in the nullah, alive and well.

Some hold the opinion that the student, not liking his first impressions of a forest life, deliberately gave the slip to the rest of the party and ran away. In favour of this theory they advance the fact that two or three years before this youth had wilfully disappeared and remained lost to his family for a month. But the circumstances of this case were different; what can easily be done in a town or village where a boy may have friends and where there are temples with priests, cannot be done in a dense forest in an unknown country by a lad who had probably never been in a forest at all before, and who had not a pice on him, as was proved at the inquiry held in the matter, with which he could buy food if he did succeed in finding his way out of the forest. Those who hold this theory also say that if he did not run away from the party as above, then he left it to visit certain holy caves on the Nagzari Nullah, advancing his well known religious tendencies as the inducement. There is, however, no proof that he knew of the existence of the caves, whilst, as will be shown present-

ly, the caves are difficult to find, situated at a considerable distance from where the party rested, and even if the way to them is known, very difficult to get at. A boy already complaining of hunger and eager to get back to camp could not be credited with the madness of starting off alone on such a journey. The caves in question are situated in one of the slopes of the Nagzari Nadi, they are visited by pilgrims once a year only at the time of Shivaratre (middle of March), and at other times are forsaken. There is a tradition amongst the natives that the caves contain a short underground route by which one can get through to Benares, and it is thought that if Gudi had known of this legend, he may have set off to try the route and got stuck in the cave and be there still. Europeans are not allowed by the priests, when there, to enter the caves. A Hindu who had made the visit to the caves described them as being situated deep in the side of the nullah, and that he had to crawl on his hands and knees through a narrow opening for 80 feet before he reached them. When I subsequently visited the scene of the student's disappearance, I tried to get some one to take me to the caves. At first the villagers declared they did not know the way, and finally said they would take me to the bank of the Nagzari Nadi, but that they would not cross the Nadi, and that I must go on alone and find the caves. They declared the bed of the Nagzari to swarm with nagins (king cobras) of great ferocity, that they could be heard moving and hissing amongst the rocks, and that (of course!) they guarded hidden treasure. As the journey would have entailed about a 7 mile walk to get to the caves, with a descent of 1,500 feet of rugged cliff and an ascent of some distance the other side, and a search for the caves above which might easily be unsuccessful, the proposed visit was put off for a more favourable opportunity. As regards the king cobras in the nullah, there very probably are some, as this reptile is not uncommon in Kanara, though not often seen, as he hunts by night as a rule. Not long ago a *Forest Officer walking down a nullah bed* noticed a heap of dry leaves rather conspicuously by itself, and stirred it with his gun-barrels. To his astonishment a head with expanded hood and two or three feet of a king cobra's body at once reared itself out of the heap, but with the head turned from him luckily. He lost no time in blowing the head off with a charge of shot.

To return again to the missing student, another theory to account for his disappearance is that he was carried off by a tiger. To account for this people say that he may have been the last of the party and may have lagged a little behind the rest, and so may have been seized and carried off suddenly before he could scream or in any way attract any of the rest of the party. Or if he did attract the attention of any of the rest of the party, that they kept quiet out of fear and were afterwards afraid even to report it. The latter part of the theory may be dismissed without consideration; as regards the possibility

of the seizure, it may be said that the forest there always contains at least one tiger, but that man-eating tigers are practically unknown in Kanara. Had, however, a tiger seized the student, even if he did so noiselessly and succeeded in carrying him off at once, some trace must have been left. The natives with the party would have found some mark of his pug, and at least Gudi's Brahmin slipper shoes must have dropped off, or his stick or his cap been found.

The last theory, and certainly that which appears to be the most tenable as well as the simplest, is that the student missed the path in some way and got lost in the forest. But the acceptance of this theory even is beset with difficulties, as will be shown. There are two ways in which he may have got lost—(1) by deliberately leaving the rest of the party with a view to seeking a quicker way of reaching camp, and (2) by temporarily leaving the rest of the party and then being unable to find the path they had taken. A walk over the ground traversed by the party on the 10th December has convinced me that there was no temptation for Gudi to leave the party with the intention of getting back to camp by a quicker way. The way they had come by was obviously that by which they could quickest return, lying as it did along a ridge to leave which meant to plunge into dense bamboo, &c., jungle on either side with broken uneven ground. Even if he had kept walking onward alone, when the party reached the pony and made the brief halt necessary for the Parsi officer to get into the saddle, he could not have missed the path without at once getting into difficulties and becoming aware of the fact, and in that case, failing to recover the path, he would have shouted. The second way in which he could have got lost is more probable, if it be really the case that he was lost in the forest. Many reasons may be imagined why he may have lagged behind or left the path temporarily for some purpose, and there is no doubt that in thick forest once the path is lost it is very easy to lose one's bearings. Supposing Gudi to have left the path and then lost his bearings, he may have walked for a considerable distance on the wrong direction always expecting to find the path again. But not presently finding it, it would be expected that he would shout and so make himself heard by the rest of the party. Shouts can be heard from long distances in this forest, and in any case it was proved on the occasion of our visit that shouts were plainly audible from the place where the students sat to the place where the pony had been left. If he had got down into a nullah, his shouts would not be audible at much distance, but he would naturally go on shouting and would not remain in one place. Further, when missed, which must have been within half an hour of his disappearance, he should not have been able to get to such a distance as not to be able to hear any of the continuous shouts which were raised to attract his attention, except on one consideration. On finding himself lost he may have

fainted from fright combined with hunger, or fallen into a fit (he was reported to have at one time suffered from fits). Supposing the lad to have been lying unconscious at the time that the search party were looking for him at first, we must further suppose that when he eventually recovered consciousness he wandered on until nightfall without even finding a way out of the forest. In the state of exhaustion and fright that he would by that time be in, it is quite possible that his strength could support him no more, and that he lay down in some part of the forest which was not visited by the search party and there expired.

To man in ordinary health and with ordinary experience this getting lost in this particular forest need not have been attended with any particular hardships. The whole of the forest is divided up into 600-acre compartments by lines 20' to 30' broad, forming lanes in the forest clear of trees, though at this time of the year full of grass and small shrubs. Any one wandering in any direction in this forest is bound sooner or later to come on to one of these lines, and by following line after line to eventually get clear of the forest by finding a road or coming out on a village. But of course in the dusk the lines could be easily missed, or a weary man ignorant of their existence might cross one without noticing it.

There is one other theory that was not stated before and that need not be dwelt upon. This is that the student got drowned in the Kali Nadi. It is not possible to believe that under any circumstances would a man descend a steep cliff-like slope 1,500 feet high to a river which runs in a contrary direction to that in which he had to go, unless absolutely dying of thirst.

The fate of Gudi is a mystery, and it is feared will remain one. It only remains to be said that the boy's father was informed of the occurrence and came to help in the search, that inquiries were made in all the villages round, and a reward offered for intelligence of the boy, dead or alive; also that inquiries were made about him in his native place in case he had really slipped away surreptitiously and turned up there; but all to no purpose.

G. P. M.

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On Thinnings in Planted Spruce.

*Abridged from an article by M. Ch. BROILLIARD in the
Revue des Eaux et Forêts, for January 1902.*

PLANTED spruce, like the sons of Eve, are addicted to original sin. In their case it lies in the equality of age and of spacing. On the other hand, they have generally a single purpose to serve in each case. It may be hop-poles, telegraph-poles, cellulose, carpentry, sawyer's timber, or what not. They are sometimes mixed with other fast-growing conifers, such as pines or larch. These three orders of facts produce complications in thinning.

In order to understand how *natural* spruce crops differ, it would be well to know their origin and history. They start from natural seeding, capricious in distribution, different in age, variable in density, from one point to the next. How were they produced? Was it in open land void of pre-existing trees or shrubs? Were they always unmixed with broad-leaved species, bushes, or beech, or silver fir? M. Mathey is probably the first, in his work on "Le Paturage en Forêt," to point out some of the accessories, alder, juniper, hazel, whitethorn, &c. Foresters whose work lies in spruce can assist. Here are a few instances recalled from the days when my work was in the mountains.

One spring day, while resting in the shade of the forest of Brey, on the edge of a mossy meadow sweeping down to the tail of the lake of Remoray, I saw young seedlings of spruce coming up all around in the open. Were there any left at the end of the summer? None seem to have survived from previous possible seedlings.

Another time, in the commune lands of Boujeons, grazed over by cattle every year, I was struck by the appearance of some bushy little spruces showing black against the sunny snow. Some of them had sent up a shoot that might be considered safe from cattle. Were not these the precursors of a forest?

Above the forest of Outriaz, or La Condamine, was a sheep pasture, with the grass, as usual, bitten down to the ground, and the gravel soil showing between the tufts. Spruce was establishing itself by degrees under the protection of juniper bushes, in spite of the daily access of the sheep. The action of each juniper sheltering its one or more spruce of six inches or more in height, was very evident. The spruce, as it became larger, produced a similar effect, so that the forest was actually spreading by the absorption of groups along its borders.

In 1857, at the bottom of the commune lands of Malbuisson, on a plateau not far from the old forest, was a very irregular but almost continuous thicket. One could still walk about in the cattle tracks, and even shoot hares between the dense clumps of spruce, each clump with its tallest and best in the centre. To-day this is probably to all appearance an even-aged crop.

In the forest of Grand-Cote, Canton Maclin, the southern slope was entirely occupied by a beech thicket. In 1857, the conservator, M. Vouzeau, and myself, at that time a Garde General, both lamented the purity of the crop. Thirty years later I had the satisfaction of seeing the leaders of spruce shooting up from among the beech. Indeed, I have seen that in many blocks covered with broad-leaved pole crops, coppice or seedling, the spruce will frequently be found, of all sizes, in the underwood, some ready to break forth into the light, some patiently waiting their opportunity; others too that had lost hope and died. But, in the long run, it was the spruce replacing the broad-leaves. Is not this likely to be how some of the splendid spruce forests of the high Jura arose?

In this region, in the mixed forests of fir and spruce, with the latter in a majority, it is usual to see the spruce reproducing itself beneath the firs, germination being favoured by the better vegetable soil formed under the latter. There, under the cover of the great firs, the spruce gathers itself together into a sort of loose ball, awaiting the light from above which shall enable it to shoot up to heaven. Under the spruces themselves the soil is generally covered with a carpet of dead needles, the vegetable soil is acid and black, and young spruces are generally absent. Under the spruce it generally happens that the seedling is of silver fir, whose heavier seed and longer taproot may succeed in piercing the dry or acid covering of the soil, and establishing a plant; thus groups of fir often replace groups of spruce. The latter, in France and particularly in the Jura, thus presents the tendency to change of place, it reproduces with difficulty on the old site, and the close crops of pure spruce seem to arise from seedlings originally very unequal in age and consistence. Consequently, early thinnings may be long deferred, and the later ones made with great moderation, without endangering the prosperity of such natural high forest.

The case is different with artificial spruce crops planted in a single operation, in lines, triangles, quincunx, &c., on bare soil.

All these plants start together and the struggle is between equals. Here comes in a question which has never had, and can never have, a general answer. It refers to the spacing of the plants. Practice varies from 2 to 10 feet. In fact the distance depends on the object in view. Hop-poles to be cut clean at about 25 years old, must be close grown, say 4,000 per acre. For paper pulp, or useful poles to be cut at about 40 years old, two-thirds of the number will suffice. For telegraph-poles or small carpentry, to be cut at 60 years, 2,000 plants will be about right. For sawyer's timber no more may be needful than 1,200 to 1,600 planted 5 or 6 feet apart, or better still if irregularly spaced.

It is true that widely spaced plants, sturdy from their youth up, make strong and quick-growing trees. But for good useful timber it is absolutely necessary that the lower branches must perish and fall while still thin, leaving a trunk clear and free from knots. Upward growth is the great point; the crown pushing rapidly up suffices amply for the prosperity of the tree when it occupies no more than a fourth of the total height.* Young growing spruce (and still more deodar.—*Transl.*) must therefore be thinned to use an Irishism, with extreme moderation, and the density must be kept as close as is consistent with good growth. Thinnings in even-aged young spruce are certainly more difficult, and more necessary, than in natural crops. The principle to be adopted is, to free the tallest and reduce their number without removing the weakest (unless their tops are dry), since these latter ensure natural pruning, cover and protect the soil, and add the strength of a close canopy. The spruce is truly named *excelsa*. Not like the ash *excelsior* "above my neighbours," but simply *excelsa*, "ever upward." The fir, though often taller than the spruce, ends by acquiring a flat, tabular top, whilst the spruce points upward to the last.

In order that the spruce may have a sufficiently rapid growth, as well as a clean pole, the crown must be allowed a duly proportionate height, say, one-fourth of the total height of the tree. This proportion can be assured by maintaining a suitable density in the crowns. If the crop is to grow on to the age of 60, 80 or 100 years, it is clear that the stems should be thinned out gradually but a little more freely, so that the rate of growth in thickness may not become too slow.

Given, for instance, a crop composed of 600 good dominant stems per acre, with an average diameter of 6 inches, by the time the stems are 12 inches thick there should be no more than 240 per acre; when they are 16 inches there may be 140 to 160, and when they are 20 inches there may be 100 to 120. The gradually decreasing severity of the operation thus becomes plain.

* Especially is this the case with deodar, which drops its dead branches with difficulty.—*Transl.*

While we remove perhaps half the stems when they are 4 to 6 inches thick, we take out no more than one-tenth when they have attained 20 inches. In any case the operation should be frequently repeated, say, every 5 or 6 years, so as to avoid anything like heavy fellings or the opening of the canopy. The true forester, imbued with the sentiment of the forest, going to work with prudence, will let his eye wander among the crowns continually, but will only take out one here and there, not one of the best nor one that is practically suppressed, for suppressed trees have their utility. The term "selection thinning" has been applied to such an operation as this, and has also been objected to on the ground that *selection means the removal of the biggest*. The objection is invalid, since the essence of selection lies not so much in the size of the trees as in the diffused nature of the felling.

The figures given above can evidently not be taken as the measure of the operation in all cases. The forester has to find this measure on the ground, for it will vary with the activity of vegetation, with the state of the crop, and with the periodicity of the thinnings themselves. Many owners would like to know how to set about finding this measure. Given a young planted polecrop hitherto untouched, containing 1,400, 1,600, or even 1,800 dominant stems per acre, with their crowns shooting up vigorously to the sky, dominated stems may be neglected. It is easy to find the number of stems per acre, since a square of 22 yards side is the tenth part of an acre. Suppose there are 160 stems, and they average 12 inches girth, they are too close, and too equal among themselves, to prosper for long; but what is the measure of prudence? When the stems are twice as thick, there should remain hardly more than one-fourth of their number. If the rate of growth gives 15 to 20 years, to attain that size, the thinning may pass thrice over the ground during the period, removing each time one-third or thereabouts of the crop. Here is the measure, one in three, the thinnest, and maybe the tallest, or oftener the mean of three contiguous stems, so as to relieve the best. At this rate after 15 or 18 years there will only remain some 440 to 480 of the original 1,600 stems. But a certain number of formerly dominant stems, notwithstanding the two first thinnings, will, by the time of the third, have fallen to the dominated state. Hence it will be wise to estimate afresh the number of dominant stems before proceeding to the third thinning. If this new estimate should produce only 560 dominant stems, the third thinning will be only at the rate of one in four, so that about 400 stems may remain. In any case the thinnings will have allowed the utilisation of all that there was to utilise. The dominated stems do more good than harm, and they should be kept so long as their leaders are not dry. Once the leader is dry, they should be utilised. A spruce that has relapsed into the dominated state does not live long, hence all broad-leaved species that may be found in the crop are valuable, and should be carefully preserved

even if they have shot up above the spruces, provided they are not too numerous. Such trees are the friend of our friends the birds, the worms and slugs, and other things that find no living in pure spruces.

Suppose, again, a fine young crop of spruce poles 40 years old, unequal in size, and the biggest of them barely 8 inches thick. There are about 400 stems per acre in the upper story which sees the sky. It is too many. In 30 years' time one half the number will be sufficient. At that time 200 stems, 70 years old, per acre, should be 14 to 16 inches thick. Three thinnings, at the rate of one in five, will halve the present number in the 30 years' period.

Always try to have some broad-leaved species in the lower-story, but especially, as the canopy is opened, introduce the silver fir. A number about equal to that of the spruce removed will ensure an excellent state of vegetation for the latter. If the situation is not too warm, the firs will prosper rapidly 20 or 30 years later, when the rest of the spruce are felled. Thus, to perfect a spruce forest, plant it with silver fir.

The statement that three thinnings are better than two is hardly capable of proof, but it is the key to the situation. If there is a case in which caution is especially needed in opening out a canopy, that case is the case of a tall spruce forest. The prescription one in four, or one in three, is not in practice carried strictly out over the whole area. Before many acres have been thinned the operator will have got the resulting density so fixed in his mind that he no longer has need to count. The degree of thinning will vary from one forest to the next, according to the activity of vegetation and other factors, which it is the operator's business to understand. The result of the first thinning will enlighten him, those of the second will confirm his experience, while the third will make him a finished forester. Later, the amateur will probably become overbold; the professional will remain cautious.

The thinning of crops beyond 70 years old can hardly be profitably discussed on paper, the proportions being so diverse and the conditions so complex, according to the variations of soil, aspect, mixture, &c., that it would be rash to give any definite figures. Still, as a last instance, may be considered the case of a much too-dense pole crop, whose dominated story has disappeared, and which contains on the average some 400 to 480 stems of 10 inches diameter per acre. An incautious thinning may imperil the whole crop, but if not thinned it will languish. By removing only one tree out of every eight or ten, the risk will be very small. By renewing the operation every four years, the total number will in 20 years' time be reduced to half. A sluggish crop will have been awakened into active growth, and perhaps some 2,800 cubic feet of timber per acre may have been realised in five operations. Each operation will be a guide to the next.

F. G.

Ailanthus grandis.

BY D. PRAIN.

THE opportunity has been taken, during an inspection visit to the Cinchona Plantation in Sikkim, to search personally for the tree described in the *Indian Forester* for April as *Ailanthus grandis*.* It was not difficult to find; it is not uncommon along the Ryang and Rungjo streams, and my Lepcha collectors tell me it is equally frequent along other streams that join the Tista.

The Lepcha name for the tree is *Maldikung*, a name that in Mr. Gamble's excellent "Darjeeling List" connotes *Garuga pinnata*. As there is said to be but one *Maldikung*, it seems as if some mistake had been made by Mr. Gamble's native attendant; the Paharia name, *Dabtabbi* given by Mr. Gamble for *Garuga*, is said by my men to be correct. The Paharia name for the *Ailanthus* is *Gogul*, a name not to be confounded with *Goguldhup*, which in Mr. Gamble's List connotes *Canarium Sikkimense*. This last connotation has been verified in connection with the present enquiry.

The use of the term *Gogul* for two distinct trees is explained, so my native informants say, by the fact that the two are very usually found together, and that they are of similar habit; they run up, as *Gurjans* do, with a clean straight stem of 80—90 feet before giving off any branches. One of my native companions, indeed, in referring to the *Ailanthus*, used the significant expression *dusera gogul*. The epithet *dhup*, applied in the case of the *Canarium*, is given because the *Canarium* yields a resin that can be used as incense; the *Ailanthus* yields no resin.

This *Ailanthus* attains a total height of 120—150 feet and so shares with *Canarium Sikkimense* and *Tetrameles nudiflora* the reputation of being one of the tallest trees in Sikkim. As regards girth, however, it far surpasses the *Canarium*, equalling *Maina-Küt* (*Tetrameles nudiflora*) without being buttressed as that tree is. My Lepchas say, indeed, that in the matter of girth it even rivals *Panisáj* (*Terminalia myriocarpa*), usually considered the giant of the Sikkim forests, while reaching a greater height than *Panisáj* ever attains. The measurements so far obtained for *Ailanthus* are, however, far from as great as some of those quoted for *Terminalia myriocarpa*, the largest at 6 feet from the ground being only 9·5—12 feet.

There is little to add to the description already given. The bark, which is rather thin, is smooth and pale whitish grey, very like the bark of *Ailanthus excelsa* as grown in the Royal Botanic Garden at Calcutta. The leaves are 5—8-jugate, usually 7-jugate, even-pinnate, the leaflets, except the terminal pair, being as a rule only sub-opposite, or, especially towards the base of a leaf, quite alternate. The leaves are exceedingly like those of a *Dysoxylum* or of a *Chisocheton* and, in the absence of fruits, might be readily

supposed to belong to a Meliaceous tree. This fact, coupled with the transfer of its Lepcha name to *Garuga* and the circumstance that it bears the same Paharia name as another tree, probably explains how *Ailanthus grandis* has been so long overlooked.

Some of the trees are now (commencement of April) in ripe fruit, and from the circumstance that, among examples of the same size and growing under precisely similar conditions, certain individuals are loaded with samaras while others have none, it is to be suspected that the species may be, at least functionally, dioecious. This point, however, can only be settled when, later in the season, flowers are obtained.

The figure of the samaras given in the *Forester* for April was taken from a specimen glued down on a herbarium sheet, and shows them as quite flat. On the trees, however, and when they fall, though a few are quite flat, the majority have precisely the apical spiral twist shown in the figured samaras of *A. glandulosa* and *A. excelsa*. This fact tends to confirm the suspicion already expressed, as to the inadequacy of the character when dealing with herbarium specimens of *A. malabarica* and *A. Kurzii*, or for that matter of any of the other species. Though the existence of an apical twist is not recorded for these, it is by no means impossible that the samaras of all of the species of *Ailanthus* are thus twisted, and that the character is a generic not a specific one.

No use is said to be made of the timber of *Ailanthus grandis*, another circumstance that helps to explain its existence having been overlooked.

GOVERNMENT CINCHONA PLANTATION,

BRITISH SIKKIM;

10th April 1902.

Notes on a Visit to the Maldive Islands.

By F. LEWIS, F.L.S.

WE left Colombo on the night of the 4th of October 1901, and after a very rough voyage, reached Malè, on the Sultan's island, on the morning of the 9th.

Viewed from the sea, the islands appear to be little green fringes of trees just above the sea-level, scattered about with narrow passages of water of very varying depth between each.

So low in fact are the islands, and flat, that they can only be seen when one is practically but a short distance off.

On getting closer to Malè, one quickly caught sight of the walls of the old Dutch fort that practically surrounds this little island. The approach is through a narrow channel of water, in which the soundings suddenly go from great depths to 50 fathoms, followed by 22, 27, 30 and 29, into an anchorage of about 26 opposite Malè Island, but this shallow course is curved and is

swept by a rapid current. Malè, it should be further mentioned, lies to the south of a large group of islands forming what is called the Malè Atoll, and is separated from a second group of islands called the South Malè Atoll by a channel that runs east and west, called War-du-kan-du, or War-du channel.

Besides these two large Atolls, there are several others extending over the equatorial belt of waters towards Madagascar, where they become included under separate groups, the whole containing a vast number of little points, the majority of which, as might be expected, are uninhabited. I do not profess to describe the whole group, as my visit was of limited duration and was only confined to Malè and the adjacent islands, upon which I could only spare a brief period of time, within which I confined myself to vigorous plant collecting and to noting objects that may throw some light on the question of the distribution of plants on these islands.

Malè must, of course, in consequence of its being the seat of Government, be regarded as the most important island of the Maldive group, though not by any means the largest. On landing by the side of the small breakwater, within whose embrace one sees a fleet of boats of all sizes, from a vessel about as big as an ordinary bath-tub to the ocean going "buggalow," the first object to catch the eye of a vegetable character is *Vinca rosea*, the pink flowers of which appear to be rather larger than the Ceylon example. This grows as a weed, but I found it on no other island. Side by side with *Vinca* just outside the fort walls I found *Cassia occidentalis* with abundant yellow flowers, closely followed by *Ricinus communis* and *Calotropis gigantea*, the last, by the way, being a common plant in graveyards, and having a white-flowered variety as well.

In the crevices of the stone forming the fort walls I found *Arun lanata* and *Oldenlandia biflora*, besides a little nettle, *Fleurya interrupta*.

Within the courtyard at the entrance of the fort are several introduced and carefully tended trees, of which *Inga Suman* was noticeable, and also an *Otax* that was well closed in.

Passing into the village portion, as distinct from the "city" and Sultan's premises, it was most noticeable that each of the streets was walled off with hedges made of *Pandanus* leaves, so as in most cases to keep the enclosed houses and gardens quite out of view, except as regards roofs. The streets are beautifully clean and well swept, and there is nothing to offend eye or nose along them; in fact Malè within the fort walls is a model of sanitation.

Graveyards are most abundant, and, strangely enough, most of the wells from which the inhabitants obtain their drinking water are shallow coral-stone lined pits surrounded by the dead. Gravestones, beautifully carved and cut, are to be found in profusion, and by a curious little pointed apex to the

headstone, in contrast to a rounded apex, one is able to define the sex of the dear departed one, the apiculate form indicating the males!

The temples are constructed of sawn coral-stone, perfectly fitting, and carved with a chaste design of most excellent finish. A favourite design is an imitation lock with a key hanging by a chain, all executed in relief and finely worked. The roof is usually of cocoanut wood, thatched over with cocoanut and Pandanus leaves.

I also found two large bathing pools pointing to Mahomedan design, but the vivid green of the water led me to conclude that while the devotees are near to godliness they were far from cleanliness.

Two boat-building yards at Malé are quite a feature of the island. In these may be found some of the most gracefully constructed craft. The "lines" are perfect in design and conception, and it must be borne in mind that as many of these boats visit distant points on the Indian Ocean, due consideration must be given to the means thus obtained for bringing seeds of plants, consciously or unconsciously, from other countries.

Indeed, the limited area of the island must have developed a strongly maritime instinct, and this in its turn evolved a perfect type of ocean-going boat.

Armed with so powerful an agent for the transport of seed, or fruit, I think it is little wonder that so much of the vegetation of the islands is common to neighbouring lands, and in this way the presence of many species, if not most, is readily accounted for.

The following catalogue of plants taken on the spot will show that while Malé contains a larger number of species, as might be expected, yet the islands close at hand have not, from want of human assistance, secured the same distribution. The absence of birds, or rather I should say the limited amount of bird life, leads one to discredit the theory that they have contributed materially to the vegetable wealth of life on the island, while the presence of currents of great force and persistence would account for many forms that have been carried by sea from other lands.

These currents are so strong, and flow with such rapidity through the sieve formed by this mass of islands, that plants common to Java, Lombok and Timor can be accounted for by seed having drifted from them; indeed, as a good instance in point, I obtained a seed of *Entada scandens* washed up on the beach of Hoolooya Island, much in the same way as I have found seeds of the same species at mouths of Ceylon rivers that have floated down from the interior.

Of monsoon wind one must also take due consideration. So marked is its force that the vegetation facing the south-west

distinctly narrows towards it, presenting the thin end of the wedge literally to it.

It is worthy of note that while Malè possesses by far the largest number of plants, a small island to the north-east and separated by only a narrow piece of water, does not contain anything like the same number, though crows and flying foxes are to be seen crossing and re-crossing. I have called this particular island "Fowl" Island, as I found it used as a "chicken" farm and there appeared to be some doubt as to its real name.

Of animals I could make only a limited catalogue, as my attention was fully absorbed by botanical work. However, I may state that I remarked that there was a conspicuous scarcity of large animals, the biggest I saw being a cow. Dogs are conspicuous by their absence; in fact so rare a creature is a dog, that when the captain's favourite came on shore it was regularly mobbed by crows. Goats are very plentiful, and do much damage to the *Thespesia* by eating the bark, and it may often be observed that these trees are bound round with stout grass ropes in order to keep the goats from nibbling the stem. The abundance of hollow trees at Malè is, I think, accounted for by the destructive influence of goats.

Flying-foxes are very common, but appear to be more so in the neighbouring islands than in Malè, but I expect that their migration is directly in accordance with the fruiting of certain trees.

Of birds there are few. The most common is the grayback crow (*Corvus splendens*), so well known in Colombo and its environs. Unlike his Colombo cousin, the gray crow of Malè is quite a confiding, guileless bird, and is not alarmed by the sight of a gun. He does not peep round a corner to see if anybody is looking when he wants to purloin some delicate morsel, neither does he wear an artful look in his glassy eye. I really believe the Malè crow is honest, moral and law-abiding.

The noisy Indian Koel (*Eudynamis honorata*) I heard on Hoolooya island with his unmistakable cry.

On this same Island I got a glimpse of a *Pozana*, but it hid itself so rapidly in some low thicket, that I am unable to record its possible species.

A little "snippet," probably *Actitis hypoleucos* I found on the beach feasting on minute molluscs.

Curlew are said to be plentiful, but the only trace I got of this species was a much ant-infested skull.

I was told that a strange magpie was common on the islands, but what this bird may be I am unable to say, as I saw no trace of it.

Except these common species of gulls, the domestic fowl and the pigeon, I saw no other birds, and I can hardly attribute

to those mentioned above the possibility of introduction of plants. I am uncertain if the stream of migration would cover the Malé Atoll on the south, but I assumed that this would be included for birds flying in the monsoon track. It is remarkable, however, that I saw no migrants in any of the islands in October—the time of my visit.

Lizards are common and plentiful. I saw four distinct species, including a *Callotes*. Mud tortoises I saw at Malé, and turtle are said to be very common.

My entomological knowledge is not sufficient to enable me to name the species of butterflies I saw, but I recognised four forms common to Ceylon, one of which was a "yellow" and one a very common *Euploea*. Beetles did not appear to be very plentiful, while black and white ants are annoyingly abundant.

The common house fly I found very plentiful, and also a large bee, who would not permit of my closer inspection: while mosquitoes abound in millions on Hoolooya in the Pandapus swamps; they are both large and pertinacious.

I am told a snake exists, but I can only record the report as I did not see it.

The people of Malé and its neighbouring islands would appear to be of Singhalese origin, judging from their language, and indeed it is said that about 1,000 years ago the Maldives were used by the Kandyan kings as a penal settlement. It is remarkable, however, that Buddhism does not exist: the people are strong Mahomedans. It is, I think, evident, that the present inhabitants are very mixed, as I noticed not only the Maldivian pure and simple, but I found Tamils, Caffres, Afghans, Moors, and pure Singhalese among them.

In build and stature the Maldivians are short, slim and well built people, but distinctly thin, both men and women. Their complexion is a paler brown than the average Singhalese, while in shape of head they are rather inferior.

Their faces are small in feature, but intelligent, with bright eyes and generally good teeth. The women are, generally speaking, slight, with a strong Burmese cast of expression.

The great problem of the distribution of species still remains imperfectly answered, but I venture to think that as regards this group of islands, much is to be accounted for by ocean currents, but more is due to human agency, conscious and unconscious, than is generally supposed, especially when the fact remains that owing to restricted area and water surroundings, the people have become a race of sailors, possessed of boats pre-eminently adapted to ocean going, and who have plied to other lands distant by thousands of miles from their own island homes, thus introducing forms that could scarcely be expected to appear.

I have thought it desirable to annex a short synopsis in which I have arranged the distribution of species found by me, sub-dividing under each head the possible causes of introduction. It will be seen from this that Fowl Island—uninhabited—gives a curious result as compared with Malé :

Malé Island.				"Fowl" Island.				Hoolooya Island.			
Introduced by human agency.	Probably by human agency.	By ocean currents.	Unaccounted for.	Introduced by human agency.	Probably by human agency.	By ocean currents.	Unaccounted for.	Introduced by human agency.	Probably by human agency.	By ocean currents.	Unaccounted for.
56	15	10	8	13	6	13	4	20	11	18	14
Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.	Percent of whole.
63%	17%	11%	8%	36%	16%	36%	11%	32%	18%	28%	22%

Catalogue of Maldivian Plants.

Anona muricata
Anona squamosa
Tinospora cordifolia
Argemone mexicana
Cleome viscosa
Portulaca oleracea
Bryophyllum calycinum
Calophyllum inophyllum
Sida humilis
Abutilon indicum
Hibiscus Solandra
Hibiscus tiliaceus
Thespesia populnea
Gossypium barbadense
Adansonia digitata
Corchorus acutangulus
Averrhoa Carambola
Murraya Koenigii
Triphasia trifoliata
Soriana maritima
Azadirachta Indica
Zizyphus Jujuba
Colubrine asiatica
Cardiospermum Halicacabum
Allophylus Cobbe
Mangifera indica
Moringa pterygosperma
Crotalaria retusa
Tephrosia tenuis
Desmodium gangeticum (?)

Canavalea lineata
Clitoria Ternatea
Cesalpinia Bonduc (?)
Cassia occidentalis
Cassia glauca
Entada scandens
Pithecolobium Saman
Terminalia catappa
Psidium guyava
Eugenia malaccensis
Barringtonia speciosa
Pemphis acidula
Lawsonia alba
Sonneratia acida
Punica granatum
Carica Papaya
Trichosanthes cucumerina
Oldenlandia corymbosa
Oldenlandia biflora
Guettarda speciosa
Morinda citrifolia
Ageratum conyzoides
Blumea membranaceus
Wedelia biflora
Launea pinnatifida
Scevola Koenigii
Jasminum Sambac
Jasminum grandiflorum
Ochrosia borbonica
Vinca rosea

<i>Plumeria acutifolia</i>	Piper Betle
<i>Calotropis gigantea</i>	<i>Cassytha filiformis</i>
<i>Tylophora</i> —?	<i>Hernandia peltata</i>
<i>Cordia subcordata</i>	<i>Agaveia bacciformis</i>
<i>Tournefortia argentea</i>	<i>Phyllanthus urinaria</i>
<i>Ipomoea grandiflora</i>	<i>Phyllanthus Niruri</i>
<i>Ipomoea biloba</i>	<i>Manihot utilisima</i>
<i>Evolvulus alsinoides</i>	<i>Acalypha</i> —?
<i>Solanum melongena</i>	<i>Ricinus communis</i>
<i>Physalis minima</i>	<i>Ficus bengalensis</i>
<i>Capsicum minimum</i>	<i>Ficus infectoria</i> (?)
<i>Datura fastuosa</i>	<i>Artocarpus incisa</i>
<i>Datura suaveolens</i>	<i>Fleurya interrupta</i>
<i>Nicotiana glauca</i>	<i>Pouzolzia indica</i>
<i>Herpestis Monniera</i>	<i>Cycas circinalis</i>
<i>Ruellia ringens</i>	<i>Musa sapientum</i>
<i>Stachytarpheta indica</i>	<i>Crinum asiaticum</i>
<i>Premna integrifolia</i>	<i>Tacca pinnatifida</i>
<i>Vitex Negundo</i>	<i>Dioscorea</i> (2 species)
<i>Clerodendron inerme</i>	<i>Gloriosa superba</i>
<i>Ocimum gratissimum</i>	<i>Commelina</i> (2 species)
<i>Anisomeles ovata</i>	<i>Areca Catechu</i>
<i>Leucas biflora</i>	<i>Cocos nucifera</i>
<i>Boerhaavia diffusa</i>	<i>Pandanus</i> (2 species)
<i>Mirabilis Jalapa</i>	<i>Ananassa sativa</i>
<i>Pisonia morindae-folia</i>	<i>Colocasia Antiquorum</i>
<i>Aerva lanata</i>	<i>Pothos</i> ?
<i>Polygonum barbatum</i>	

The time at my disposal was too limited for me to collect grasses, of which I saw several interesting forms, and one example of a much dwarfed bamboo. I observed a few mosses and lichens, but I may now draw attention to the absence of orchids or of any species of *Loranthus*, the last being a circumstance of significant interest when regarding birds as being the means for the introduction of species.

My catalogue is far from being complete, but I must plead for it that it was the result of less than a day and a-half's work.

It will be noticed that the three islands I visited had distinct forms, though none that are new or peculiar, while I submit that most of the species recorded above are accounted for as being introduced by human agency, and a very limited number to ocean currents.

III.-OFFICIAL PAPERS AND INTELLIGENCE.

Quarterly Report on Enquiries conducted at the Imperial Institute for the Government of India.

*By Professor WYNDHAM R. DUNSTAN, M.A., F.R.S., Sec. C.S.,
Director of the Scientific and Technical Department of the
Imperial Institute.*

SINCE the date of my last quarterly statement, a further report (report on the tanning materials of India, Part III) has been sent to India on the value of the pods of *Caesalpinia digyna* as a tanning agent, which fully confirms the favourable opinion expressed in my first report. Tanning trials have now been conducted with this material with excellent results, and samples of tanned leather accompanied my report. A commercial demand has already arisen for this product, and the question now resolves itself into one of supply.

The attention of this department having been drawn by the Foreign Office to the valuable tanning properties of the pods of the Chilean *Caesalpinia brevifolia* or algarobilla, experiments have been made with material provided by H. B. M. Consul in Chile, and in the report referred to, I have asked for information as to the attempts which are said to have been made to introduce this plant into India.

The principal subjects now engaging the attention of the department are other tanning materials, aconites, gums and fibres. The investigations connected with these subjects have now been actively resumed after the summer vacation.

At the request of Mr. F. R. Mallet an examination is being made of a sample of graphite from a deposit found by Dr. T. L. Walker of the Geological Survey of India, in the Kalahandi State of the Central Provinces.

1st October 1902.

Forest Statistics in the Madras Presidency.

By H. L. A. PORTER, *Acting Conservator of Forests, Central
Circle, Madras.*

The enclosed statement shows the area of forest charges and other statistics for the Madras Presidency. Madras Forest Officers would be glad to see similar statements for other provinces published in the *Forester*.

Statement shewing the District and Forest areas, Revenue and Expenditure, Forest offences in the Madras Presidency

Districts.	Total district area.	Area of zamindari and inam villages	Government Lands.	Reserved Forests.		Reserved Lands.	Total area of Reserved Forest and Reserved Lands.
1	2	3	4	5		6	7
	Sq. m.	Sq. m.	Sq. m.	No. of blocks.	Sq. m.	S. m.	Sq. m.
NORTHERN CIRCLE.							
Ganjam ..	8,369	3,932	4,437	46	501	39	540
Vizagapatam ..	17,242	15,862	1,380	44	224	120	344
Godavari ..	7,857	3,866	3,991	83	951	1	952
Kistna ..	8,498	2,877	5,621	179	839	229	1,068
Kurnool ..	7,514	855	6,659	58	2,232	539	2,771
Bellary ..	5,696	1,054	4,642	136	545	86	631
Anantapur ..	5,563	862	4,701	76	508	2	510
Total ..	60,739	29,308	31,431	622	5,800	1,016	6,816
CENTRAL CIRCLE.							
Cuddapah ..	8,723	1,153	7,570	188	2,129	308	2,437
Nellore ..	8,765	4,691	4,074	190	698	68	766
Chingleput ..	3,092	1,041	2,051	194	213	1	214
North Arcot ..	7,365	3,453	3,912	188	1,196	38	1,234
South Arcot ..	5,216	469	4,747	154	693	12	705
Salem ..	7,529	2,138	5,391	156	1,323	258	1,584
Trichinopoly ..	3,631	946	2,685	112	264	52	316
Tanjore ..	3,706	1,219	2,487	15	18	..	18
Total ..	48,027	15,110	32,917	1,197	6,534	737	7,271
SOUTHERN CIRCLE.							
South Canara ..	3,902	19	3,883	92	647	443	1,090
North Malabar, ..	5,630	28	5,602	21	201	46	247
South Malabar ..				13	223	48	271
The Nilgiris ..	957	..	957	334	397	101	498
North Coimbatore, ..	7,860	684	7,176	38	1,108	542	1,650
South Coimbatore. ..				18	657	1	658
Madura ..	8,813	5,568	3,245	145	598	13	611
Tinnevely ..	5,389	1,822	3,567	57	424	5	429
Total ..	32,551	8,121	24,430	718	4,255	1,199	5,454
GRAND TOTAL. ..	1,41,317	52,539	88,778	2,537	16,589	2,952	19,541

number and forest area of Ranges, details of establishment and number of for the Forest year 1900-1901.

REVENUE.		EXPENDITURE.		No. of Ranges.	Average area of Reserved Forests and Reserved Lands per Range.	ESTABLISHMENT.							FOREST OFFENCES.	
Total.	Per square mile of R. F. and R. L.	Total.	Per square mile of R. F. and R. L.			Provincial Service No.	No. of Rangers.	No. of Dy. Rangers and Foresters.	No. of Forest guards.	Sq. mile of R. F. and R. L. per Guard.	No. of Watchers and Tannadars.	Sq. mile of R. F. and R. L. per W. & T.	Total No.	No. per square mile.
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Rs.	Rs.	Rs.												
53,850	100	48,935	91	6	90	..	5	6	45	12	38	14	379	1
32,684	95	36,383	106	2	172	..	2	5	20	17	36	10	565	2
1,97,553	208	79,953	84	7	136	..	7	12	45	21	164	6	421	1
1,31,951	124	74,312	70	5	214	..	5	9	45	24	203	5	1,492	1
1,61,653	58	1,25,065	45	7	396	1	7	14	50	55	143	19	967	1
1,30,254	206	67,281	107	4	158	..	4	7	40	16	105	6	684	1
71,172	140	38,325	75	3	170	..	3	7	40	13	75	7	522	1
7,79,146	114	4,70,254	69	34	200	2	33	60	285	24	764	9	5,030	1
1,23,432	51	1,01,378	42	8	305	2	8	16	80	30	155	16	1,632	1
1,43,926	188	91,604	120	5	153	1	5	7	45	17	98	8	1,029	1
40,969	19	34,870	163	2	107	1	2	5	30	7	64	3	1,452	7
1,34,429	109	88,370	72	6	206	1	6	14	76	16	206	6	2,739	2
1,01,797	144	55,551	79	5	141	1	5	9	57	12	187	4	3,220	5
2,93,012	185	1,71,032	108	8	198	1	8	13	74	21	196	8	2,592	2
78,420	248	40,206	127	5	63	1	5	4	30	11	100	3	1,105	3
18,862	1,048	8,088	449	1	18	..	..	3	3	6	15	1	224	12
9,34,847	129	5,91,099	81	40	182	8	39	71	395	18	1,021	7	13,939	2
69,410	64	83,564	77	4	273	..	4	7	45	24	66	17	498	1
31,996	130	77,800	315	2	124	..	2	5	22	11	20	12	18	..
2,21,625	818	1,28,992	476	3	90	..	3	6	19	14	22	12	19	..
40,513	81	94,209	189	4	125	..	4	7	40	12	18	27	219	1
1,31,365	80	90,552	55	5	330	..	5	10	40	41	108	15	284	1
63,303	96	96,647	147	6	110	..	5	10	40	16	88	7	339	1
97,540	160	51,403	84	5	122	1	5	10	40	15	118	5	1,190	2
74,002	173	53,670	125	6	72	..	6	13	54	8	109	4	531	1
7,29,780	134	6,76,837	124	35	156	1	34	68	300	18	549	10	3,107	1
24,43,773	125	17,38,190	89	109	179	11	106	199	980	20	2,334	8	22,130	1

V.-SHIKAR AND TRAVEL.

The Indian Pheasants and Their Allies.

By F. FINN, B.A., F.Z.S.

[Continued from p. 192.]

CHAPTER II.

PEAFOWL AND JUNGLEFOWL.

As these two genera are so well known and so easily recognized, it is just as well to begin with them, although they have no special relationship to each other beyond belonging to the same family. But it is always best to proceed to the unknown from the known, and a consideration of the generic and specific characters of these familiar birds will prepare us for the study of the other groups of the family.

It is often stated, even by high zoological authorities, that genera have no real existence in nature, but are only the invention of naturalists for cutting up the numerous species into

manageable groups, the species themselves being presumed to be real enough. This notion is entirely fallacious. A genus is or should be a group of species, each of which more closely resembles all the other species of that group than it does any other species outside. This being so, a genus is just as real a thing as the species of which it is composed, and this is obvious enough in the rare cases when the separate species and the whole genus each have a popular name. For instance, it would be absurd to admit the existence of the carrion crow, our old friend the Indian house crow, the raven, rook, and jackdaw, and then say that the genus "Crow" or *Corvus* in scientific language, which includes all these, did not exist except in the imagination of naturalists. A "crow" is a big (more or less) black bird of certain physical attributes, and most people recognize the existence of the genus before they know the species.

In the case of the birds now under consideration the characters of the genera are particularly well marked and recognizable. To take the peafowl first. By "peafowl" we understand birds having the general characteristics of the Pheasant family as described above, with the additions of certain peculiarities of their own—large size, small heads with bare faces, and crested, long necks and legs, and, in the males, the upper tail coverts, or feathers of the lower part of the back, of a loose filamentous texture and of enormous length, reaching several feet beyond the tail itself, which is of quite ordinary structure. The males are spurred, and sometimes the females also.

Peafowl are polygamous in their habits, several females associating with one male, who displays himself to them by "spreading out his tail," *i. e.*, erecting and spreading his upper tail-coverts with the tail braced up behind. But this gesture is common to hens and young birds also under any excitement, and it is very doubtful whether the peacock knows what he looks like, in spite of his age long reputation for pride. And, although peahens are known to display marked preference for particular cocks, it has never been proved that they choose the most beautiful. So there is a great deal to be made out even about these familiar birds.

Peafowls are lovers of trees, on which they roost at night, and like many game birds, prefer to be near water. Their flight looks less laboured than that of other birds of this tribe, as their large wings flap comparatively slowly, but they cannot sustain a lengthened flight, and may even in some cases be run down. But they are very strong on their legs, and run remarkably well. They have the reputation of affecting the vicinity of tigers, and it would be interesting to know the reason of this. It is possible that the same locality suits both creatures, and that the birds, from their very fear of the tiger, are led to keep near him in order to be informed of his movements, which certainly interest them, as they are always very wary birds.

The note of the peacock has always been cast up to him as a defect, but it is really not an unpleasant call when heard far enough off; and it has evidently given him his name in several languages, the Greek *Taos*, French *Paon*, German, *P/au*, Dutch *Paauw* and Hindi *Mor*, all distinctly recalling the well known note. Another point against these birds is their destructiveness in gardens; but against this may be set the great virtue that the peacock is well known to destroy small snakes, even of poisonous species. Moreover peachicks are excellent for food, although the old birds are too tough for anything but making soup of. The genus *Pavo* is only found in South-east Asia, and comprises two species, of which by far the best known is our familiar Indian bird.

THE COMMON OR INDIAN PEACOCK.

Pavo cristatus, Blanford, Fauna Brit. India, Birds, Vol. IV, page 68.

Native names:—*Mor*, *Manjur*, Hind.; *Taus*, P. *Landuri* (the female), *Mahr Manja* (the female), *Mania* (the female), Uriya; *Mabja*, Bhutanese; *Mong-yung*, Lepcha; *Moir*, Assamese; *Dode*, Saro; *Myl*, Samul; *Nimili*, Telegu; *Nowl*, Canarese; *Mouara*, Cingalese.

In this species of peafowl both sexes possess a crest formed of feathers webbed only at the tips, so that each is like a little fan with a long handle; moreover the bare skin of the face is white, and the female's plumage is altogether different from the male's, even allowing for the absence of the train.

The cock's head and neck are of a lovely rich greenish blue; his back golden green with black edgings, making the feathers look like scales; the train or long tail-coverts, green changing to copper-red, with blue-and-purple eye-like spots; the real tail is brown, and wings are pale dun or creamy buff with irregular black bars, except the pinion-quills, which are bright chestnut, and the nearest secondary quills which are black. The under parts are black with a green gloss, except the thighs, which are light drab.

The hen has a chestnut head and white throat. Her general colour is drab, with the quills and tail darker, and the lower part of the breast buffy white; the neck has a strong green gloss, as has also the tip of the crest.

Young cocks are at first like hens, but have a certain amount of black pencilling; their chestnut quills will also distinguish them at once. They are three years in coming into full colour.

Both sexes have dark eyes and dark horn colour bills and feet. A fine cock may measure more than seven feet to the end of his train; the real tail is twenty inches in length only; and the closed wing about two inches less. The shank will be about five and three-quarter inches long, and the bill nearly two from the gape.

The hen is a little over a yard long, and has a proportionately shorter true tail, this being only thirteen inches, and the closed wing sixteen; the shank about five only.

This is the peacock *par excellence*, for although confined as a wild bird to India and Ceylon, it has been domesticated for many centuries, and is known all over the civilized world.

It does not ascend the Himalayas, as a rule, over 2,000 feet, though it may range above 5,000 on the Nilghiris; which makes it somewhat remarkable that it can bear the English climate in winter without protection. Where exactly it meets the green peacock, next to be noticed, is not exactly known as yet, but it extends to the eastern limits of Assam.

In many places it is held sacred and found in a semi-domesticated condition, this being the case in Sind, Guzerat, Cutch and Rajputana. In any case, it is to be hoped that this magnificent bird will be spared as much as possible by sportsmen everywhere, since for its peculiar beauty it has no rival, save the even more magnificent bird next to be described.

Peafowl are not so quarrelsome as most of this family, for several males may be seen showing off together. The hens usually lay in the rains about half-a-dozen eggs of some shade of buff, and nearly three inches long. The nest is of course usually on the ground, but has been met with in elevated situations, and it is worth knowing that the eggs are delicious eating.

Buff varieties of this peacock have been met with in the wild state, and in domestication it is sometimes white or pied, and at times produces a most remarkable variety, the Japan or black-winged peacock (*Pavo nigripennis* of Sclater). In this form the cock's wings and thighs are black, the former being glossed with blue and green; the pinion quills remain chestnut. The hen of the variety is white, grizzled and splashed above with black, with a black tail, and with chestnut pinion quills like the cock. The legs in both sexes are dirty white, not dark as in the normal form. The variety is distinct from the egg, the chicks being white, though the young cocks soon show dark feathers. Were it not definitely to originate, in either sex, as a "sport" from the ordinary tame peafowl, this variety would certainly be ranked as a good species, since as a general rule it breeds true, and even though smaller and weaker, ultimately swamps the original type when all breed indiscriminately together in domestication.

It is said to have once occurred wild in India, and any specimens procured should be carefully preserved. It cannot be expected to be common, since its colour in the females and young is much against it as an inhabitant of our jungles.

THE GREEN PEACOCK.

Pavo muticus, Blanford, Fauna Brit. Ind., Birds, Vol IV, page 70.

Native names :— *Daung*, *Udaung*, Burmese ; *Marait*, Salain ; *Susia*, Karen ; *Burong marah*, Malay.

In this species the hen, except for the absence of the train, closely resembles the cock; the crest in both sexes is longer than in the common peafowl, and composed of feathers webbed all the way down, but gradually broadening from the root upwards, and with rounded tips; the bare face also is blue above and yellow below; moreover the present bird is a little larger.

The cock's plumage bears a general resemblance to that of the common peacock, but differs strikingly in the neck, being bronze green, the feathers being of scale like appearance. Moreover, the wings, except the chestnut pinion-quills, are black with a blue and green gloss, and the thighs black, as in the blackwinged variety of the common bird. The hen has the same bronze-green neck and dark glossy wings and underparts as the male, but her back is dark brown, coarsely pencilled with buff, instead of green as in the cock, and the train is replaced by feathers of a more ordinary length and texture, though reaching to the end of the tail; these are golden green with irregular coarse pencilling of buff.

Young birds are like her, but show some buff edgings to the feathers.

This species extends from Chittagong to Java, being the ordinary peafowl of Burma, but it is local and not abundant in most places, though it is so in some parts of Upper Burma. Little is known about its breeding. In captivity it has crossed with the common peafowls, the hybrid, judging from a young male in the British Museum, exhibiting a mingling of the colours of the parents, but in its crest following the common species exclusively.

The only other peacock hybrid I know of is that between the common peacock and the guinea-fowl, a specimen of which was figured in the *Field* recently, and was noticeable as lacking both the train and crest of the one parent and the helmet and wattles of the other; this seems to be the usual result of such remote crosses.

The jungle fowls are birds of a very different type, and also stand much alone, although they have an obvious affinity to the ruffed pheasants, to be mentioned later. Their characteristic points are the comb, large in the cocks and small in the hens, and the vertically folded tail, the undersides of the feathers facing each other. These characteristics apply to both sexes; the cocks alone, however, have the two central tail feathers long and curved, and are furnished with long and sharp spurs, besides differing altogether from the hens in colour. Jungle fowls, except that they carry their tails low, much resemble tame fowls of rather small size, and are thus very easily recognizable; the various species are very distinct from each other, and only four in number; three of them occur in our limits.

(To be continued.)

VI.—EXTRACT NOTES AND QUERIES.

The Flowering of stool shoots of *Dendrocalamus strictus*.

WE all know of the tremendous efforts made by bamboos to propagate their species when their time for flowering has come. Even though the bamboo may be cut down and hacked about, shoots, as most of us have seen, are produced which flower and often bear mature seeds from the sides of the small portion of the culms which have been left.

I have just come across a case showing this vitality and power to such an extraordinary degree that it may interest your readers.

A small bamboo hut had been built at a place called Palauing in the Yaw Division by the Bombay-Burma Trading Corporation (who hold the lease to work teak in the Yaw forests) on the top of a very steep hillock close to the abovenamed village. On clearing the ground to build the hut all the bamboos (*Myinwa*, *Dendrocalamus strictus*) had in December last been cut quite or almost flush with the ground. In the first week of March I happened to stay at this hut *en route* to do some girdling. I arrived after dusk. Next morning whilst my elephants were being loaded I noticed on the ground close to the hut several small heaps, as it were, of bamboo flowers about 7 inches diameter and 3 to 4 inches high. On examination they proved to be almost solid rounded masses of *Myinwa* flower in full bloom, apparently growing out of the solid earth, without leaves or stem; here and there around each group of these masses of flowers were further little buttons of flowers pushing through the ground resembling more than anything which I can think of, the way in which a young mushroom pushes its way up. On further examination these small compact masses of flower were found to be growing from the base of the culms just below the surface of the ground on short stems which were entirely concealed by the flowers and some earth.

On the small patch of ground cleared I found that three clumps of the bamboos had flowered in this way. I presume that had these clumps of *Myinwa* (a sporadic flowerer) not been cut down they would have flowered in the ordinary way.

I have never seen a similar case, though no doubt some of your readers may have; if so it would be interesting to hear their experiences.

PAKOKKO: }
19th March 1902. }

F. J. BRANTHWAITE.

The specimens have apparently miscarried, for they have never reached us.
—HOS. ED.

Dendrocalamus strictus damaged by Monkeys.

A DAY or two ago in the Mou West Reserve (Minbu Division, Upper Burma) I noticed that nearly all the culms of *Dendrocalamus strictus* for some miles had been damaged and were abruptly broken off at a height of 12 to 15 feet, giving the clumps a flat-topped appearance.

The injury, it appears, is caused by monkeys feeding on the growing points of the shoots of the year, breaking them off at some height from the ground.

The culms are rendered valueless, and considerable loss of revenue results, as the area is easily accessible from the Môn River, down which large numbers of bamboo rafts are floated.

CAMP : }
21st March 1902 }

C. E. MURIEL.

An Old Definition of a Forest.

I HAVE before me an old black letter volume printed in 1615 under the title of "A Treatise of the Laws of the Forest," from which some extracts may be found as interesting to others as to myself. Chapter II, Section 4 is headed "Whereof the same receiveth the name of a Forest"* and runs as follows: "Although, that this word Sylva, a wood, be oftentimes taken and translated for a forest, as in the 104 Psalm of the King and Prophet David, verse 20. And likewise this word Saltus, a Wood, is often translated for a forest: as in the second book of Kings, the second chapter, verse 24. And yet neither this word Sylva, nor Saltus are properly Latin words for a forest, but rather for a wood, and are taken and used for a forest because that a forest is a place full of woods, and therefore a good Forester is called a good Woodman: For, albeit that of late time we used to say Forestarius, a Forester, yet the ancient writers do rather say Saltuarius, a Woodman, which doth prove that a forest in the Latin tongue hath his name derived from the word Sylva or Saltus, a Wood, because that wild beasts have always had their abiding places in woods: but yet it doth not therefore follow that every wood is a Forest, although that there be Deer and other wild beasts in the same, except that the same wood be specially privileged by the King for them to rest in a firm peace. And such a wood so privileged is called by Budæus, in his second book De Philologia, Sylva sacrosancta, a privileged wood for wild beasts to be safe in. And in another place, he calleth a forest Saltus sacrosanctus, a privileged wood for wild beasts; so that a wood privileged for wild beasts, and a forest, are all one, or, as it were, divers words of one signification. Budæus useth this word Saltuaria sacrosancta, for a forest; for speaking of matters of Hunting, he saith this, these

*The modern form of spelling has been adopted.

woods, in which the herds of wild beasts are privileged, even by the Canons of Princes laws, those we call forests, saith he. And hereupon the Latinists have framed this latin word, forest a, for a forest, being compounded of these two words, fera and statio, so that foresta, est ferarum statio, which is that a forest is a safe abiding place for wild beast. And even according to the same manners, imitating the Latinists, we have framed this English word, a forest being compounded of these two words, for, and, rest: And because a forest is a safe abiding and privileged place for the Kings wild beasts for rest, which words (For and Rest) being put together and made one word, is forest, or a forest, taking his name of the nature of the place, which is privileged by the King for his wild beasts, to have their safe abiding in forest. Budœus in his Treatise of Hunting in French useth to say, une forest, for a forest, little differing from our English word, forest, or from the Latin word foresta."

May our woods speedily become forest is the wish of

S.E.W.

THE INDIAN FORESTER.

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July, 1902.

[No. 7.

Universal Volume Tables.

*Translated by E. M. C. from an article by H. Algan in
the Revue des Eaux et Forêts.*

WHEN an inventory of a forest is made either for the sale of the produce or the calculation of the possibility, it is customary, instead of calculating the cubic contents of the trees one by one, to place them in diameter classes 5 to 5 centimetres apart. The trees are measured man's height and the volume of the type tree of each diameter class is determined. In order to do this, a certain number of trees in each class are felled which appear to have the form and height which approach nearest to the average. The volume of each of these trees including the branches is determined, and the mean volume represents the volume of the type tree. The series of volumes of the type trees of the different diameter classes constitutes what is called a volume table for the forest, block or compartment. However numerous the experiments made, this table nearly always presents some irregularities which can be diminished or made to disappear by employing the graphic method which H. Huffel, Professor at the Nancy Forest School, has explained in his work "Les arbres et les peuplements forestiers" (p.61).

The preparation of these tables is a long and expensive operation, especially when a forest is stocked with several species and has different conditions as regards soil, elevation and aspect. Suppose that a forest contains firs, beech and pines, and that it is possible to separate the portions of which it is composed in three distinct groups with respect to the height and shape of the trees, it would be necessary to draw up for each of the groups as many tables as there are species, i.e., for the whole forest nine different tables. Is it necessary for working out these tables to fell in each group a certain number of firs (type trees) of all the diameter classes, to calculate the cubic contents of all these trees, and to do the same for the beech and afterwards for the pines? In practice we are contented with felling and finding the cubic contents of

trees 20, 30, 40 cm. in diameter, and knowing the volumes of these trees, we have also approximately and by interpolation the volumes of trees 25, 35, 45 cm. diameter. Measurements made previously on trees felled in the coupes can be utilized, but we are not always sure that they have been carefully made and on trees of average height and shape. However, it can be understood how the preparation of tables would be facilitated by the knowledge of the relation which exists between the volumes of trees of different sizes. A few years ago when publishing their "Tarif conventionnel unique pour l'application du contr  l au traitement des for  ts" MM. de Blouey and Jobez wrote as follows in their preface:—"It is necessary that every volume table should express the general progress of the vegetation, and we regret the absence of any studies and experiments regarding the relation which exists between the diameter and the cubic contents of trees during different phases of their existence." It is precisely on these studies that I have long been engaged, and which I have followed in the Vosges and the Alps, in high forest and in coppice, aided by the good counsel and judicious advice of my colleague M. A. Schaeffer.

These studies show that, with rare exceptions, trees double in volume in increasing from 20 to 25, from 30 to 40 and from 45 to 60 cm. diameter. That they will be triple afterwards, if they attain 1 meter in diameter.

The tree of 20 cm. diameter will have ten times as great a volume when it measures 50 cm. diameter, and those of 25 and 30 when they measure 65 and 80 cm. respectively. From 35 to 70 cm. diameter the volume increases five-fold, from 65 to 90 it doubles, &c.

These different relations do not appear to be influenced by the situation or soil, nor do they vary with the species. Two examples will explain my meaning. First, suppose in a valley with deep and fertile soil we have a well grown oak of 45 cm. diameter. If its volume is 2.7 cubic meters, we may be certain, if there is no accident, that it will contain about 5.4 cubic meters when it reaches 60 cm. diameter. On the other hand, suppose a Scotch pine of the same diameter on a steep, rocky slope, exposed on all sides to the sun, it will have a much smaller height and will be more conical and contain (say) 1.2 cubic meters. This pine will also double its volume in increasing from 45 to 60 cm. diameter. From 1.2 its volume will become 2.4 cubic meters.

This can be expressed in another way. In a portion of any forest, homogeneous as regards the conditions of vegetation, the volume of the tree of 60 cm. diameter is double that of the average tree of the same species which measures 45 cm.

The following table is a typical table, which gives all the relations which exist between the volumes of trees of the same species and of different diameters in the same portion of a forest.

It must be noted, however, that the trees are all measured at man's height, by which is understood the point above the root buttresses where the trunk begins to take a regular shape.

Diameter at man's height. Centimeters.	Volume. Cubic meters.	Diameter at man's height. Centimeters.	Volume. Cubic meters.
20	0.2	60	3.6
25	0.4	65	4.3
30	0.7	70	5.1
35	1.0	75	5.9
40	1.4	80	6.7
45	1.8	85	7.6
50	2.3	90	8.6
55	2.9	95	9.7
		100	10.8

It will be noticed that this table is very regular, *i.e.*, that the curve, constructed with the diameters as abscissæ and the volumes as ordinates, does not present any sinuosities, and this must be so, for *Natura non facit saltus*. However, those who would draw this curve will have the regret or the satisfaction of finding there some quite small angles, and they will make the objection that the increase in volume from 25 to 35, from 35 to 40, 55 to 65 and 65 to 80 and 90 to 100 cm. diameter ought not to be rectilinear, that the curve passing from one diameter to the next ought always to rise. This is incontestible. But here it is best to leave well alone. For in order to make the curve continuous, it would have been necessary to retain not one but several places of decimals for each of the volumes expressed in cubic meters. This would be a useless complication, seeing that the employment of decimals, either for the inventory of the stock in a forest or for the estimation of fellings would have the sole result of rendering calculations longer and more tedious and at the same time increasing the chances of mistakes. I have therefore thought it best to omit the second place of decimals. Thus the volumes are correct to at least $\frac{1}{20}$ cubic meter.

But a single table would, evidently, be insufficient for the inventory of all forests, as there are many degrees of difference in the height and shape of our trees. Consequently I have drawn up 20 tables on the same plan. They are very regularly graduated, for it will be seen that from one table to the next the volume of trees of 45 cm. diameter is increased always by 0.1 cubic meter. This scale of 20 tables is sufficiently extended to permit the determination of the cubic contents of all forest crops, however poor or excellent the growth may be. In fact there is scarcely a forest where the volume of the average tree of 45 cm. does not attain 0.9 cubic meters (Table 1) and doubtless there are no forests in our climate where the volume of this tree exceeds 2.8 (Table 20).

Diameter at height of a man in centimeter.		VOLUME IN CUBIC METERS.																			
Diameter at height of a man in inches.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	7 87	0.1	0.1	0.1	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.25	0.25	0.25	0.3	0.3	0.3	0.3	0.3	0.4
25	9 84	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7
30	11 81	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1
35	13 78	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6
40	15 75	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2
45	17 72	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
50	19 68	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.5	3.6
55	21 65	1.5	1.6	1.8	2.0	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.3	3.4	3.6	3.8	3.9	4.0	4.2	4.4	4.5
60	23 62	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6
65	25 59	2.1	2.4	2.6	2.9	3.1	3.4	3.6	3.8	4.1	4.3	4.5	4.8	5.0	5.3	5.5	5.8	6.0	6.2	6.5	6.7
70	27 56	2.5	2.8	3.1	3.4	3.7	4.0	4.2	4.5	4.8	5.1	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.3	7.6	7.9
75	29 53	2.9	3.2	3.6	3.9	4.3	4.6	4.9	5.2	5.6	5.9	6.2	6.5	6.9	7.2	7.6	7.9	8.2	8.5	8.8	9.2
80	31 50	3.3	3.7	4.1	4.5	4.9	5.3	5.6	6.0	6.4	6.7	7.1	7.5	7.9	8.3	8.7	9.1	9.4	9.8	10.1	10.5
85	33 46	3.8	4.2	4.7	5.1	5.6	6.0	6.4	6.8	7.2	7.6	8.1	8.5	9.0	9.4	9.9	10.3	10.7	11.1	11.5	12.0
90	35 43	4.3	4.8	5.3	5.8	6.3	6.8	7.2	7.7	8.1	8.6	9.1	9.6	10.1	10.6	11.1	11.6	12.1	12.5	13.0	13.5
95	37 40	4.8	5.4	5.9	6.5	7.0	7.6	8.1	8.6	9.1	9.7	10.2	10.8	11.3	11.9	12.4	13.0	13.5	14.0	14.6	15.1
100	39 37	5.4	6.0	6.6	7.2	7.8	8.4	9.0	9.6	10.2	10.8	11.4	12.0	12.6	13.2	13.8	14.4	15.0	15.6	16.2	16.8

1 Centimeter = 0.3937 in.

1 Cubic meter = 29.53c.ft.

And now having these 20 tables at our disposal the only question is to choose one or the other.

If, for example, we find in a certain area that the average tree of 50 cm. diameter contains 2.5 cubic meters, we shall adopt table No. 11 for that area. If in another compartment we find that the average beech of 45 cm. contains 2 cubic meters and the oak of 55 contains 3.8, table No. 12 will apply to the beech and No. 15 to the oaks. Thus a few measurements made with care on a small number of well-chosen type trees of 2 or 3 diameter classes or even of a single class will be sufficient to indicate the table which should be employed. If the trees of two diameter classes have been measured, it may happen that the average results obtained do not indicate the same table, *e. g.*, we find that the average tree of 40 cm. contains 1.5 cubic meters, corresponding to table No. 12, and that the tree of 60 contains 4.4 cubic meters, corresponding to table 14. In this case we adopt table No. 13, or we make a third experiment and determine the volumes of a few trees of another diameter class. It is also best that the trials made to fix the choice of the table should be made on trees of one of the classes best represented in the crop rather than on specimens of the extreme classes. This will save much time and expense, not only to the organizer but also to purchasers, for they also will sometimes be able to make use of these tables instead of estimating the volumes of trees marked for sale one by one as they ordinarily do. Finally, the employment of this series of 20 graduated tables will have another advantage for foresters. The use of vague expressions will be avoided. Tell us that table 18 is used for your oaks; or that table 2 is used for your pines and we shall know what to expect. In brief, give us their number and there will no longer be any doubt. There is one condition, however, *viz.*, that it must be understood that the gross cubic contents are always given, branches included. Failing this the products of different coupes, forests and blocks will no longer be comparable. The proportion of timber to fuel for each class should be known from the results of previous fellings.

The foregoing tables converted into inches and cubic feet are as follows :—

VOLUME IN CUBIC FEET.

VOLUME IN CUBIC FEET.																				
Diameter in inches at man's height.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
6	2.2	2.2	2.2	3.3	3.3	3.3	4.5	4.5	4.5	4.5	4.5	5.6	5.6	5.6	6.7	6.7	6.7	6.7	6.7	8.9
9	5.4	5.4	5.4	8.1	8.1	8.1	10.8	10.8	10.8	10.8	10.8	13.5	13.5	13.5	16.2	16.2	16.2	16.2	16.2	18.9
12	9.0	12.0	12.0	15.0	15.0	15.0	18.0	18.0	18.0	21.0	21.0	24.0	24.0	24.0	27.0	27.0	30.0	30.0	30.0	33.0
15	19.7	22.5	22.5	25.3	28.1	30.9	33.7	33.7	36.6	39.4	39.4	42.2	45.0	47.8	50.6	50.6	53.4	56.2	59.1	61.9
18	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0	51.0	54.0	57.0	60.0	63.0	66.0	69.0	72.0	75.0	78.0	81.0	84.0
21	43.0	45.8	51.5	57.3	60.1	65.9	68.7	74.5	80.6	83.0	88.8	94.5	97.4	103.1	108.8	111.7	114.6	120.3	126.0	128.9
24	54.0	60.0	66.0	72.0	78.0	84.0	90.0	96.0	102.0	108.0	114.0	120.0	126.0	132.0	138.0	144.0	150.0	156.0	162.0	168.0
27	72.3	81.0	89.7	98.4	107.0	115.7	121.5	130.2	138.9	147.5	153.3	162.0	170.7	179.4	188.0	196.7	205.4	211.2	219.9	228.5
30	87.0	96.0	108.0	117.0	129.0	138.0	147.0	156.0	168.0	177.0	186.0	195.0	207.0	216.0	228.0	237.0	246.0	255.0	264.0	276.0
33	110.6	112.3	136.8	148.5	163.1	174.7	186.3	198.0	209.6	221.3	235.8	247.5	262.1	273.7	288.3	299.9	311.6	323.2	334.8	349.4
36	129.0	144.0	159.0	174.0	189.0	204.0	216.0	231.0	243.0	258.0	273.0	288.0	303.0	318.0	333.0	348.0	363.0	375.0	390.0	405.0

The Influence of Forests on Cultivation in the Hills.

By RAM SWARUP, D.D.R.

APART from the reserved forests, the forests in the Kumaun Civil Division of the United Provinces have, till only very recently, received little or no State protection, consequently the surrounding people have come to regard them as their own property and become accustomed to cut as much as and whatever they liked in the most extravagant manner. If they wanted a shaft for a plough, they felled a gigantic oak, axed out a couple of shafts and left the rest to decay; if they wanted a handful of torch wood, they scooped it out from a 200 year old pine tree, which, weakened by the wound, would soon be blown down by the wind. But the most destructive practices were *khil* cutting or the practice of shifting cultivation, and the annual firing of forests for fresh grass for cattle. These have been so often described that I need not enter into their details. Suffice it to say that as under these unchecked practices forests often were destroyed and people were obliged to go further and further to fetch the grass and wood for their consumption, Government at last thought fit to appoint a scanty establishment and frame a few rules to prevent the further destruction of these forests, with due regard to the supply of the *bonâ fide* agricultural and domestic requirements of the people.

The latter, however, unanimously opposed the measures framed for preservation of their forests and declared the rules to be oppressive. Nor is it strange that they should so think, because they are ignorant and see nothing beyond their present requirements. But it is somewhat surprising to find a district officer discountenancing the reform and favouring the annual burning of forests, because it sometimes happens that the accumulation of slippery pine needles causes accidents to cattle. I wish therefore to try to prove in the following lines that the existence of forests near cultivation, so far from having any deleterious effects, is almost absolutely necessary for its proper development.

The advantages accruing to cultivation from forests are of two kinds—direct and indirect.

The direct advantages are timber for building, wood for fuel and agricultural implements, grass and leaf fodder for cattle, and leaves for manure as well as pasture land for cattle and edible fruits and roots for human beings, especially in times of drought and scarcity. In almost every climate and most conspicuously so in dry climates grass not only grows up more abundantly, but also comes up earlier on wooded than on perfectly open land. A crop of new grass will often come up in the midst of forest growth even if the summer rains have been delayed, and grass may be found in the forest even in the height of hot season.

Before enumerating any indirect advantages let me state that irrigation in the hills, besides being very expensive, is seldom

possible owing to the physical features of the country, and except along the banks of large rivers, and even there to a very limited extent, is seldom resorted to. Well digging is practically impossible. Therefore cultivation entirely depends upon rain, which in turn depends to a great extent upon the humidity of the atmosphere.

The presence of forest growth renders hill slopes stable and checks denudation. The whole root system, anchored fast in the solid rock below, holds together, even on very steep slopes, loose crumbling rocks or soil which would otherwise slip or be washed down and destroy the cultivation below. When rain falls the crowns and trunks of the trees sustain the first shock and allow it to come down to the ground very slowly. The dead vegetable covering also lessens this shock to a great extent. According to Ebermayer only 75 per cent. of the total rainfall reaches the ground, the rest either evaporates or runs down the stems of the trees, the latter being perhaps one half the intercepted quantity. The rain which reaches the ground is to a great extent retained by the covering of dead leaves, and slowly filters down through the loose impeding mass into the drainage channels. Thus in forests the water seldom rushes down the hillsides and does little damage to the soil. The streams and, at other times, dry ravines rarely become swollen torrents, and the larger water-courses never run dry. The water that sinks into the ground is partly absorbed by the roots and finds its way through the leaves back into the atmosphere which it keeps moist, while the rest filters downwards and re-appears below to feed or form springs.

In the same way if snow falls the trees catch and retain a large portion of it, and what reaches the ground is held there by trunks of trees and the low vegetation, whereby heavy drifts and avalanches are prevented. When warm weather comes the snow thaws gradually, first on the tree-tops, then on the ground and latest of all in the deep tree-sheltered ravines.

The crowns of trees, as long as they are in leaf, shelter the soil and retard evaporation from it, and if they become leafless, the covering of dead leaves, the grass and other low vegetation are still there to prevent it from losing its moisture except very gradually.

If there are no forests the direct losses to the cultivator of timber for building, wood for fuel and agricultural implements, fodder and manure are obvious.

The rain falling directly on the soil causes furrows and ravines, and flows unchecked down the slope with great velocity, often causing landslips and injuring the cultivation below. Very little of the water sinks into the ground to form springs, and as the soil is exposed to the direct rays of the sun, it soon becomes baked and cracked, thereby rendering the surrounding atmosphere quite dry, and the effects of dry soil and an equally dry atmosphere are no doubt injurious to the surrounding cultivation.

This is no mere theory, but the fact has been forcibly brought home by repeated famines and periods of drought in those parts where there are little or no forest. Even this year, in the Garhwal district, those parganas which have least forest have suffered most from scarcity, while in those which have plenty of forests the crops are as good as ever.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Termes Taprobanes—White Ants as a Pest of Trees.

Compiled in the Office of the Department of Land Records and Agriculture, Central Provinces.

MUCH damage is caused by white ants to trees in the Central Provinces. The damage is greatest to young trees, whose roots and trunks are attacked by white ants so freely that in some parts it is only with the greatest difficulty that trees can be grown. Many attempts to make roadside avenues have failed owing to the attacks of these pests. Much damage is also often caused to mature trees by ants, which attack the tree at any spot where the bark has been broken or where there is dead wood and which form mud encrustations on the trunk.

2. Experiments have been made for years past to find an effective remedy against the ravages of white ants. Experiments to find a remedy.

Amongst other experiments, mixtures of water with tobacco, kerosine oil, salt, Sunlight soap and other substances has been tried, and whilst some of these preparations were quite successful in killing the ants reached by the fluid, they failed as a preventive, the effect being only temporary.

3. At the suggestion of Dr. Watt, Reporter on Economic Products, trials were made in 1897 of the preparation known as Gondal Fluid. Some trees were treated with this fluid in the Government gardens and farm at Nagpur, with most satisfactory results. A stimulus to further experiments was given by the publication of Dr. Watt's report on tea blight, which was distributed to all districts, with suggestions that extended trials of Gondal Fluid should be made. Much could not be done during the famine of 1899-1900; but during the past year, reports have been received of several trials, which are thought to be of sufficient interest to justify the publication of the results.

4. In the Nagpur district, experiments were tried on a large scale both to roadside avenues and to trees in Court of Wards villages, some of which were badly affected by white ants. The results are reported to have been uniformly successful; but no details are given, beyond the statement that young trees, considerably damaged by white ants, soon revived after the application of the fluid.

5. In the Betul district 400 trees were treated, and the results were entirely successful, the trees being quite free from white ants after a lapse of six months.

6. One hundred and seventy-five trees were treated in the Chanda district, some of which were much damaged by white ants. The fluid was applied in July 1901, and there was no renewal of the attacks of white ants up to the end of January 1902.

7. The results of trials in the districts of Hoshangabad and Nimar are reported to be quite successful; but no details are given.

8. In Saugor 100 trees of several varieties (mango, pipal, shisham, &c.) attacked by white ants were treated in October 1900, with successful results, the trees being free from white ants in January last. The cost of preparing the paint was Rs.5-12-6, which comes to less than one anna per tree.

9. Some trees were treated in the Seoni district during the past hot weather, with successful results, except in some cases where the fluid was washed off by showers of rain. This would seem to indicate that a time for using the fluid should be chosen when it is not likely to be immediately washed off by rain.

10. The Narsinghpur district report shows that the results were generally successful; but it brings out the interesting fact that the fluid must be carefully applied, particularly to trees with a rough bark. Care must be taken to see that the fluid penetrates to all the crevices, or else a channel will be left up which the ants will climb.

11. More than 200 trees were successfully treated in the Bilaspur district. The cost of the actual preparation of the fluid was Re.1-8-0 only, which is less than 2 pies per tree, whilst the whole cost, including labour for applying the fluid, was only Rs.4-5-0.

12. Some experiments were made in Raipur the results of which are reported to be failures. The effect lasted only a short time, the trees being again attacked within a period of two months or less. Repeated applications had no better result. This is so opposed to the successful trials in the districts mentioned above, that it gives rise to the suspicion that the fluid used in Raipur was not properly prepared, and this suspicion receives some support from the fact that the report speaks of the trees being painted with the red "powder," whereas the mixture at the time of application should be a thickened compound of the consistency of paint. If the mixture was applied in the form of a powder, this would account for the failure.

13. Some few trials at Sambalpur are also reported to be failures; but no information is given concerning them.

14. The general results are most satisfactory and justify trials on a much more extended scale. They indicate that the effect of one application lasts for at least eight months throughout one monsoon. It has yet to be ascertained whether the effect will last through a second monsoon.

Preparation of Gondal Fluid. 15. For convenience of reference, I reproduce the receipt for the preparation of Gondal Fluid.

Take—1 part *dekamali* gum (the resin of *Gardenia gummifera*);
2 parts *asafoetida* (*hing*);
2 parts bazar aloes (*gugul*);
2 parts castor oil cake (*erandi ka bagda*);

pound and mix thoroughly; then keep in water for about a fortnight; when thoroughly decomposed into a thickened compound, add water till the mixture is the consistency of paint. The experiments have all been made without adding the refuse of *al* dye to the mixture, so that there is no need to add this substance; but it is advisable to add some colouring matter, such as red ochre (*geru*), so that it can easily be seen what trees have been treated.

Cost. The material can easily be procured in the bazar, and the cost should not ordinarily exceed about Rs.3-2-0 for a sufficient quantity to treat 600 trees.

16. The fluid should be applied in a continuous band round the trunk of the tree to a height of about 2 feet from the ground. This part of the trunk must be brushed free of ants and quite cleaned of all mud encrustations. Care must be taken to see that the fluid penetrates into all the crevices of the bark.

Method of application.

V.—SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

By F. FINN, B.A., F.Z.S.

CHAPTER II—(continued from p. 232).

THE jungle fowl are fond of cover, and roost on trees at night, a habit which the tame fowl has retained. His habit of crowing at night is, however, an original invention on his part, for which mankind used once to thank him, but now, alas! legally indicts as a nuisance.

Jungle fowl are often found in pairs, though a cock naturally likes to have a harem if possible, and they are very hard fighters. The cocks show off by slanting themselves over to one side, as is constantly seen in the tame fowl.

THE RED JUNGLE FOWL.

Gallus ferrugineus.—Blanford, Faun. Brit. Ind., Birds, Vol IV, p. 75.

Native names :—*Jangal-murgh* (cock), *Jangli-murghi* (hen, Hindi ; *Ban murghi*, Hindi ; *Kukar*, *Kukra*, *Bankukar*, Beng. ; *Ganja* (cock) Uriya ; *Pazok-tohi*, *Tang-pling*, Lepcha ; *Nag-tse-ja*, Bhotanese ; *Bir-sim*, Kol ; *Gera gogor* (cock), *Kuru* (hen, Gond ; *Taukyet*, Burmese ; *Kura*, Chittagong.

In this, the best known species and the ancestor of all our tame poultry, the face is naked in both sexes, though less in the hen than the cock, and there is a flap of skin below the ear, the "ear-lobe" of poultry-fanciers. The wattles, fleshy flaps of skin on each side of the throat, are usually wanting in the hen, whose comb is also very small. Even in the cock the comb, which is of the notched "single" type so familiar in tame fowls, is not so large as one as is carried by these.

The cock's plumage is black below and orange red above the neck and rump, being covered by long, loose-textured feathers.

called "hackles" by fanciers. The tail, which has long curving upper tail-coverts hanging along each side of it, is glossy deep green, and the wings are a fine study in the arrangement of plumage, being deep glossy red, dark metallic green, black, and chestnut, put together in a diagrammatic manner most useful to ornithological students, for the minor wing-coverts, the small feathers along the front edge of the wing, are black, the median, red, the major, metallic green, forming a conspicuous bar; while the primaries or pinion quills are dingy black with paler edges and the outer halves of the secondaries or fore-arm-quills are cinnamon. Thus by getting hold of a tame cock which shows the jungle-fowl colours, and such are not at all uncommon, one may master several technicalities with great ease.

After breeding the cock casts his long neck hackles and tail feathers, the neck becoming clothed with a short black feathering. It is somewhat remarkable that no such change takes place in the tame fowl, even out here.

The cock is well over two feet long, with a wing about nine inches and shank three inches.

The hen is brown above, the colour being produced by a very fine pencilling of black and buff; below she is a plain reddish brown. Her neck, which is covered with short hackles, is streaked with black and gold, and the side feathers of the tail are black. It is a curious fact that few tame hens are coloured exactly like this.

The hen is about seventeen inches long, with a wing just over seven and shank about two and a half inches.

Young cocks, as usual, are much like the hen at first. The comb and wattles are red, and the face reddish flesh-colour; the beak dark brown, eyes red, and legs slate colour. The ear-lobes are usually white in Indian specimens and red in those from further east, which also tend to be redder in plumage.

This species ranges from India, through Burma and the Shan States, to Siam, Cochin China, the Malay Peninsula and many eastern islands; but its precise natural range is not quite certain, as, being the ancestor of domestic fowls, it is apt to give rise to feral or secondarily wild races, owing to the escape or intentional liberation of tame poultry. It especially frequents low elevation on hills, and likes cover near cultivation; and in such places it often interbreeds with its tame descendants.

The voice of this bird is just like that of the tame fowl, but in the case of the cock's crow the resemblance is to that of the Bantam breeds, the last note being short. It breeds from March to June, laying up to eleven pale buff eggs in a rough nest on the ground. The eggs are small, scarcely exceeding two inches in length.

The red Jungle-fowl is practically confined to the region where the sal-tree (*Shorea robusta*) grows; so much is this the case that an isolated wood of this tree, near Pauchmarhi in the

Denura valley, is occupied by this species, although the gray jungle-fowl (*Gallus sonneratii*), presently to be noticed, holds all the territory round about. The reason for this would be a very interesting subject for inquiry, and no doubt some forest officer will be able sooner or later to afford a solution of the problem. The red jungle-fowl is a very hard fighter, and no doubt the jungle has some special attraction which makes him keep it to himself. In a domesticated state this species is found, as everyone knows, all over the world where it can be got to live, and its endurance of cold is most remarkable considering its main origin.

Many breeds have of course been raised from it by the selection of variations in shape and colour, but India seems to possess no particular breed except the fighting Aseel and the long lanky Chittagong, the "Malay" of home fanciers. Both of these are characterized by very small combs and wattles and short glossy plumage, which in the cocks often resembles that of the wild bird, but in hens apparently never or very rarely. The Aseel, however, is short and sturdy, not lengthy in make like its relative.

With regard to the foreign breeds now being imported, I should advise any of my readers who is starting to keep such fowls, to avoid all the feather-legged and five-toed varieties, such as the Brahma, Cochin, and Dorking, such monstrosities of structure sadly handicapping a fowl's usefulness. In Calcutta there can generally be obtained excellent black China fowls, the "Langshan" of the fancy at home. This is a large bird of somewhat the Cochin type but less clumsy, and with very little feathering on the legs; many imported birds, in fact, having none. This is an excellent general utility fowl, and personally I should never trouble to send home for stock while such can be had in the country.

THE CEYLON JUNGLE-FOWL.

Gallus lafayettii, Blanford, Faun. Brit. India, Birds, Vol. IV.

Native names:—*Weli kukula* (the male), *Weli kikili* (the female), Cingalese; *kala koli*, Tamils of Ceylon.

The cock of this species bears a strong general resemblance to the red jungle-cock, but is orange red below as well as above, the breast feathers being glossy and pointed—very like hackles, in fact. The secondary quills of the wing are also purple black instead of chestnut.

The throat and most of the rump-feathers, which are not so long and hackled as in the continental bird, are glossy violet, and the tail has a purple rather than a green gloss.

The comb also in this species has a yellow patch in the middle; the face and wattles are darker, and the legs are yellow instead of slate colour.

The hen is quite as different in her way from the red jungle-fowl hen; she is of much the same partridge brown hue above, but has no distinct hackle on the neck; her wings are boldly barred

with black, and her underparts not cinnamon, but mottled black, brown and white, becoming lighter further back. Her legs are yellow like the cock's. She has no wattles, and is feathered on the face.

Young cocks are redder above and darker below than hens. The size of this species is about the same as that of the red jungle-fowl, except that the cock's tail is longer; the hens, on the other hand, appear to be shorter in this species.

The Ceylon Jungle-fowl is confined to the island "where every prospect pleases;" but the parts thereof that especially gratify the tastes of the bird are the northern jungles and the southern hills. There seems to be a good deal of variation in the breeding season and also in the number of eggs laid, which is given as from two or twelve by different authors. There is nothing noteworthy about the appearance of these eggs.

The crow of the Ceylon cock is very different from that of the rival chanticleer of India, being two syllabled and commonly rendered as a call to one "George Joyce." A Ceylon planter, however, told me recently that the general opinion now-a-days was that the bird's friend's name was "John."

The cock is a gentleman of somewhat Don Juan-like instincts, and apt to intrude on the domestic happiness of village roosters without the excuse that the red jungle-fowl can offer of community of descent. But there is as yet no proof that the offspring of these *mésalliances* is fertile, much as the present species resembles the Indian ancestor of the domestic fowl.

THE GREY OR MADRAS JUNGLE-FOWL.

Gallus sonneratii, Blanford, Faun, Brit. India, Birds, Vol IV, p. 78.

Native names:—*Jungli murghi*, Hind.; *Komri*, Mt. Abu; *Pardah Komri*, Gondhi; *Ran-kombadi*, Mahr.; *Kathe kozhi* or *koli*, Tamil; *Adavi kode*, Telugu; *koli*, *kad koli*, Canarese.

This species also is much of the same size as the red jungle-fowl, but in the cock the tail runs very distinctly longer, and may measure as much as a foot and-a-half long. The tail-coverts, however, are not long and curved as in the red jungle-fowl, nor are there any hackles on the rump.

The general colour of the cock is dark grey, the feathers having white shafts and grey edges, the wing quills and tail are purple black, and the neck feathers and those of the upper back and flap of the wing are tipped with sealing wax-like spots, orange on the wing and golden yellow on the neck. These curious tips are formed by a coalescence of the barbs of the feathers into a horny plate, and are found in a few other birds not at all allied to this family. There are rudimentary spots of the kind on the rump feathers, and a tinge of red on the flanks.

The bill is horny colour, comb, wattles, and face red, the "ear-lobe" being indicated by a fold of skin; and the legs are usually said to be yellow, but in a very fine cock now in the

Calcutta Zoological Garden they are salmon colour. The cock moults his hackles after breeding like the Red Jungle fowl.

The hen, which has a very small comb and no wattles, is of a partridge brown above with no distinct hackles, and white beneath with black edges to the feathers, getting narrower further back; her legs are dull faint yellow, and her comb a very dull red.

This bird, which is very striking in appearance and much admired by everyone who notices it, is confined to Southern and Western India, inhabiting hilly jungle and ranging even to the tops of the Nilgiris and Pulneys. It is found, says Dr. Blanford, "near the eastern coasts as far north as the Godavari, and in the Central Provinces its limit is some distance east of Sironcha, Chanda and Seoni. It is found throughout the Nerbudda valley west of Jubbulpore, and in parts of Central India and Rajputana, as far as the Aravalis and Mount Abu, but no farther to the northward or westward. It is met with near Baroda, but has not been observed in Kattywar." In spite of the local intrusion of the red jungle-fowl into the grey's territory, mentioned in the account of the former species, it will be seen that on the whole their habitats are very distinct. But of course they meet occasionally. Jerdon says that near the junction of the Indravati with the Godavari he heard both species crowing within a few yards of each other, and shot one bird which was an undoubted hybrid—a remarkable fact, for hybrids between such distinct species as these are rare in nature.

Hybrids between this jungle-fowl and common poultry are not, however, very difficult to obtain in confinement; they are more or less fertile, and one skilful fancier at home found that his crossed birds bred any way, indiscriminately, so that they showed practically no sterility. This being the case, it is possible that some of the tame fowls in the South of India have grey jungle-fowl blood; but the traces would soon be lost, as the beautiful gold-spangled hackle tends to disappear even in the first cross.

I may here venture to reprobate the recent attempt to introduce the red jungle-fowl into the Neilgherries. I have every sympathy with acclimatisation when reasonably conducted; but considering that the grey jungle fowl is in the Neilgherries already, I think the introduction of the red is a great mistake. For, in the first place, it may probably not succeed, because if the red jungle-fowl could thrive in Southern India it would have got there already; or if it does, it will lead to the grey species being mongrelized or driven out by the red, if the latter prove the stronger bird, as it probably is; if, on the other hand, the grey prove the stronger, there will be a certain amount of interbreeding, and the red will be crossed out and go to the wall. In any case it would be a great pity to lose the Madras jungle-fowl, which is quite unique in its way, and needs protection and cultivation, as a good many cocks are killed for their skins, which are in consider-

able demand among salmon-fly-dressers and makers of ornamental feather work. This using of birds for feathers is all very well, as I pointed out in the introduction, but it needs careful regulation, and I sincerely hope that sportsmen and forest officers in India will do their best to preserve and encourage this bird.

The grey jungle-fowl differs very much in voice from the red bird and its poultry-yard descendant; but as authors say, the crow is very hard to describe, and as I have never heard it, I merely mention that it is not short, like that of the Ceylon bird, but fairly long, being represented sometimes by "*kuk-kaya-kyakuk*." Birds I have seen in confinement had a peculiar alarm-note when approached, sounding like "*kourchy-kourchy*," quite different from the cackle of the common fowl.

The breeding season of this bird varies, being usually from March to July, but on the western side of the Neilgherries it is from October to December. The eggs number from seven to thirteen, and are buff-coloured and laid as usual on the ground, with sometimes a few dry leaves below.

On account of its beautiful and distinct appearance, the sport it affords—for it is a wary bird—and the value of its feathers, this would be a good species to acclimatize outside India wherever there is a warm dry climate. Thus it would be excellently suited for turning out at the Cape, or in Australia or California; such extension of the habitat of a desirable bird where it does not interfere with another equally desirable, being in my opinion really justifiable acclimatization.

Apropos of this I may mention that the only remaining species of jungle-fowl, the green jungle-cock of Java and other eastern islands, ought certainly to be acclimatized somewhere—the Andamans, for instance, where there are no jungle-fowl of any sort at present, or some of the West Indies. This beautiful bird is mostly black, with an orange patch on the wing, and a ruff of round-tipped bronze green feathers instead of the usual neck hackle. He has no wattles, but an expansible dewlap rather like a turkey's, and his comb is not notched. It and the dewlap are most exquisitely coloured with puce and pale blue, with a yellow patch on the latter; and the face is flesh-colour, often flushing to scarlet.

(To be continued.)

VI.-EXTRACTS, NOTES AND QUERIES.

The Danger of Wood-Pulp Paper.

"LIKE the leaves of the forest when autumn hath blown," books within twenty years show discoloured and broken leaves, the beginning of a decay that will make them valueless probably within a generation. The use of wood pulp in paper-

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making has given the public cheap newspapers and cheap books, which are good things. It has accelerated the rate of decay of whatever is printed on it, which is also, at times, a good thing. At other times it is not, and to guard against the loss that might be caused by the decay of valuable documents, the public printer at Washington and the Government Stationery Office at London require that no mechanical or ground wood pulp shall be introduced in making paper supplied to them for book printing and for written documents paper made from rags only is used. In the case of printing papers the defects are mainly those of recent progress. Matthias Koops, who, in 1801, took out the first patent for making wood paper, produced sheets that recent examination showed to be of good quality and in good preservation. Koops sliced the wood he used and the fibre was preserved. He used aspen and willow, free from the resin that characterises spruce, and which if not boiled out, is a weakening element in the sheets of paper produced. Chemical wood paper, made from sliced wood, is free from the most marked of the defects that characterise the ground pulp article; but if it is not carefully made the impurities detract from its durability, and it, too, is liable to turn brown and become brittle. The Prussian Government was the first to notice and provide against the danger of defective material in public documents. It established standards of quality and defined tests to which paper for all official documents was subjected. In recent years the public documents issued by the American and British Governments are not found with discoloured margins, the beginning of the process of deterioration, that is often noticed in those produced after 1880, when wood pulp paper began to be generally used in book printing. In the case of written documents, paper made from rags being used, they are practically permanent, though in their case also the use of chlorine in producing the white shade now called for in the paper has a tendency to weaken its strength. Care in the Stationery Department is necessary for the public protection, even in their case.—*The Publishers' Weekly*.

Substances obtained by the Destructive Distillation of Wood.

MR. GLEADOW sends us the following table (taken from the *Revue des Eaux et Forêts*) of substances which are obtained by the destructive distillation of wood. These are of course not obtained direct by simple distillation, but by the addition of various chemicals and appropriate processes in each case:—

WOOD.	PYROLIGNEOUS ACID.	Raw Acetic Acid.	Pyrolignite of lime, brown ...	Commercial acetic acid.
				Acetone.
				Chloroform.
			Ditto grey ...	Iodoform.
				White acetate of lime.
			Pyrolignite of soda ...	Acetate of copper (neutral verdigris) for disease of vines.
			Ditto fritté? ...	
			Acetate of soda, crystals ...	
			Ditto powder ...	
			Ditto lump ...	Acetic acid, comestible.
		Raw methylene.		Pyrolignite of lead.
				Acetate of lead.
				Pyrolignite of iron.
				Acetate of alumina.
			Common methylene ...	For varnish makers.
			Methylenes for denaturising purposes ...	French statutory types.
				Other statutory types.
			Methylene for making aniline dyes ...	Formaldehyde (Formalin).
				Carbonate of creosote.
				Phosote (Phosphate of creosote).
	Tar.		Creosote ...	Taphosote (Tannophosphate of creosote).
				Creosoform (creosote and Formalin).
				Tannocreosoform.
				Gualacol, liquid.
			Gualacol ...	Carbonate of gualacol.
			Gualacol, crystals ...	Phosphate of gualacol.
				Gualaform.
				Tannogualaform.
			Pitch and tar ...	Pitch and tar.
CHARCOAL.	Charcoal.		Charcoal ...	Charcoal.
			Ditto broken ...	Ditto broken.
			Ditto Dust ...	Iron-foundry, black.
				Charcoal dust bricks.

Much used in pulmonary diseases.

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Insect Life in a *Terminalia* Post.

By E. P. STEBBING, F.L.S., F.E.S.

Terminalia tomentosa is a tree of some value in parts of India. In the Central Provinces it is in demand for rafters, &c., used in the construction of bungalows. Whilst in Seoni in August last year my attention was drawn to the state of the roofs in some newly-built bungalows put up by the Bengal-Nagpur Railway. A 2'-3" gauge line is being run through the heart of the Central Provinces by this Company, and the bungalows in question were erected for the housing of the officials on the construction work. They had the ordinary thatched roof so common in the country, the rafters carrying the superstructure of bamboos and thatching grass consisting of roughly-barked *Terminalia tomentosa* posts. On entering the verandah of one of these bungalows, I noticed that the easy-chairs, table, &c., scattered about were dotted here and there with small patches of wood dust, and a glance upwards to the exposed roof structure showed that both the rafters (*Terminalia* posts) and the bamboos were being badly riddled by borers. Mr. C. O. Hanson, the Deputy Conservator in charge of the Seoni Division, who was my companion at the time, informed me that most, if not all, the roofs of the new bungalows were in a similar state, some being very bad indeed. One of these latter I was subsequently shown, and the number of beetles at work in the roof was very large. The opportunity for continuing researches, already commenced, into the habits, &c., of borers of this kind was not to be lost, and at my request Mr. Hanson very kindly undertook to obtain one of these attacked rafter posts for me. Through the courtesy of the railway officials he was able to redeem this promise the following month (September). The post was sent up to me in lengths together with some insects cut from a portion of it by Mr. Hanson. These were similar to some of those described below.

A detailed examination of the different portions showed that two great Orders of the *Insecta* were present, the *Coleoptera* or beetles and the *Hymenoptera* or ichneumon flies, ants, bees, and wasps, &c. The representatives of these Orders were however, as we shall see, present with very different objects. The borers had tunnelled into the post with the *bonâ fide* intention of laying their eggs in the wood on which the larvæ, as soon as they hatched out, would feed. Others had entered the post through the holes bored by the wood-borers with the intention of feeding upon these latter, either in their larval, pupal, or imago stages. Others again were parasitic on some of the insects infesting the wood, their eggs being probably laid upon the larvæ of these latter. Thus we see that as a first step in our investigation work we may divide the insects found infesting the post at the time of its receipt in September, including those bred out during the two following months of October and November, into three groups having entirely different habits :—

1. Insects present in the rafter post with the object of feeding upon the wood and laying eggs in it, the grubs from which bore into and further weaken it, finally developing into beetles which would probably continue the attack.

2. Predaceous insects, present with the object of feeding upon the wood borers in their various stages of larvæ, pupæ, or imagos. These live in the galleries of the borers, hunting in them for their prey. They will often be found to have the same diameter as their hosts, thus accurately fitting into their tunnels.

3. Parasitic insects living upon either of the above, in this case I think upon the wood borers: this point is however not yet settled. These insects are essentially parasitic, their larval stages being spent inside the larval or pupal stages of their hosts, on whom they feed whilst still living. They make no active use of the galleries made by the host as do their predaceous comrades.

The insects in these three groups will be shortly described below. I should mention that in addition, there were in the post several other larvæ whose determination has not yet been effected owing to perfect insects not having been obtained from them. The wood was so riddled that it was almost impossible to make out any distinctive characters in the work of the borers. No less than ten different species of insects were cut or bred out between the middle of September and the middle of November; the dates on which each mature insect was obtained were carefully noted, as also those on which larvæ or pupæ were found in the wood. These latter are of course essential information in working out the life-histories of each of the insects found—life-histories of which we till recently knew practically nothing. Now, thanks to Mr. Hanson and the Seoni Railway Officials, Messrs. Gellert and Townsend, we have notes as to where and in which stage of their existence the insects spend two to three months out of twelve in the year. The

remaining and larger portion of the life-histories have still to be worked out.

We will now consider in detail the insects found, dealing in turn with each of the three groups into which I have roughly divided them.

The wood borers.—The wood borers present were all beetles (Coleoptera) and were all members of the family *Bostrichidae*. The Bostrichids belong to the Pentamerous group of beetles, so-called because they have five joints to the tarsus of all the feet. The family is further classed under the Serricornia (serrate antennæ) division of that group. The tarsus, although 5-jointed, has the first joint very short and imperfectly separated from the second, and unless the joints are closely examined, the inexperienced observer will confuse them with the four jointed tarsus of the family *Scolytidae* or bark borers. The front coxæ—the coxa is the top joint of the leg joining it to the body—are prominent and contiguous. Typical Bostrichids are remarkable for their variety of sculpture and for the shapes of the posterior parts of the body; this part of the insect is more or less conspicuously truncate and furnished with small prominences. The larvæ or grubs of these beetles have the posterior part of the body incurved and have three pairs of short legs.

The genera present were *Sinoxylon*, *Xylopertha*, and *Lyctus*. The genus *Sinoxylon* was represented by *Sinoxylon crassum*, Lesne, a largish brown, shining, oblong beetle with reddish-brown antennæ and tarsi. The body is truncate posteriorly and has prominences on this portion. The beetle is just under half an inch in length. It has also been found in India boring into *Dalbergia Sissoo* and *Acacia Catechu* wood.

The second wood borer present proved to be a species of the genus *Xylopertha*, and is not unlikely new to science. This beetle has a superficial resemblance to *Sinoxylon crassum* but is half the size and is yellowish-brown in colour, with ten-jointed antennæ, the last three joints forming a terminal club and the joints 3-7 being together longer than the 1st joint, 8th, of the club; the front tarsi are covered on their inner surfaces with long hairs.

In the genus *Lyctus* the head is prominent, the body long and narrow and the club of the antennæ is two-jointed, whilst the outer apical angle of the anterior tibiæ (shanks of the leg) is prolonged. The beetle in question, *Lyctus* sp. which is not unlikely to also prove an undescribed one, is chestnut-brown in colour, and as will be seen from the above characters, is quite different in appearance from the other two wood-borers. It is a little over one-sixth of an inch in length.

The Predaceous Insects.—The predaceous insects are represented by several families of beetles. All the ones described below belong to the great Pentamerous group.

Teredriosoma intrusum, Mars., is a small compact beetle belonging to the family *Histeridae*. It is black, shining, with a very hard integument and short bent antennae ending in a compact club. The elytra leave two dorsal segments of the body exposed behind. This latter characteristic, together with their hardness and compactness, all the joints fitting very accurately together, render these beetles easy to distinguish. The insect is between one-fifth and one-sixth of an inch in length. *T. intrusum* is carnivorous in both the larval and beetle stages of its life, and was probably feeding upon the *Sinozylon crassum*, and perhaps included in its bill of fare the other wood borers as well. At the Changa Manga plantation (Punjab) I have found it feeding upon *S. crassum* in sissu wood in this way.

Teretrius indus, Lewis, is a small beetle, not unlike the above and belonging to the same family. It has proved new to science, and was very kindly named for me by Mr. G. Lewis, the well-known English authority on this family. It also is probably carnivorous, and owing to its smaller size it is not unlikely that it confines its attention to the smaller of the wood borers.

Trogositita rhyzrophagoides, Walk., belongs to the family *Trogositidae*. Its larvae are eminently predaceous and destroy other larvae in large numbers, and it is probable that the perfect beetles do the same. The beetle is long and rather narrow, flat, with prominent head and mandibles and squarish prothorax. The club of each antenna is bilaterally asymmetric. The elytra are finely channelled (striated), colour dark brown and length one-third of an inch.

Hectarthrum brevifossum—Is another predaceous beetle not unlike the last in general appearance, but is larger, being a little over half an inch in length, black and shining, with long closely-jointed antennae, prominent mandibles and elytra broadly striated. This beetle has been previously obtained from a block of *Shorea assamica* wood from Assam. The wood, it is said, was badly tunnelled by a species of the family *Cerambycidae* (longicorns) and the *Hectarthrum* beetle was possibly feeding upon the larvae of the *Cerambyx* beetles.

Bothrides sp., another beetle new to the British Museum, belongs to the family *Colydiidae*, insects with antennae terminating in a terminal club and with four-jointed tarsi, the joints being long and narrow. The beetle in question is small, about one-sixth of an inch in length, narrow, with deeply channelled elytra. Colour very dark brown and length about one-eighth of an inch. This insect probably preys upon the smaller wood-boring larvae. The members of this family are by no means all carnivorous. They are a most interesting group owing to their great diversity of form, to the extraordinary sculpture and clothing exhibited by many of them, and to the fact that most of the known members are attached to the primitive forests of the world and disappear entirely when these are destroyed. It is to be feared that many species must,

owing to so little having been accomplished in the study of our Forest insects, have already become extinct in this country, and their position in the Insect World will forever remain an unfilled blank.

A species of *Lathreticus* very near *L. oryzae*, Waterh., was also present. This beetle is orange in colour, not unlike the last in general shape and size, but the striae on its elytra are fine in comparison with those of the *Bothrides* beetle. I have not as yet been able to determine the habits of this small beetle: length about one-eighth of an inch.

Parasitic insects.—This group is at present represented by a single specimen of a hymenopterous insect belonging probably to the *Braconidae*, a parasitic family of four-winged flies very similar and closely allied to the great family of the *Ichneumonidae* (Ichneumon flies). I am of opinion that this insect was not improbably parasitic upon the *Sinoxylon crassum* larvæ, but further observation is required upon this point. The Bracon lays its eggs in the larvæ of its host, and the grubs emerging from these eggs feed upon the living larva. They may pupate within the host, or when full grown they may tunnel out of him and pupate outside in the galleries in the wood. The mature flies come out by the holes bored by the wood-boring beetles. They are yellowish-brown in colour, with long antennæ, and the characteristic ichneumon shape, and are about one-tenth of an inch in length.

The above short and rough account of the insect inhabitants of a riddled terminalia post, whilst showing how great an insight into the operations of the insect world may be obtained by studying what one so often hears carelessly alluded to as a 'worm-eaten' post, will at the same time, I trust, draw attention to the great economic and scientific value of the results derived from such observations. In this particular instance it may be contended that although the scientific results obtained from the study of the post are undoubtedly of some importance, yet the value of the economic portion of the investigation is by no means so obvious. I think however that this argument will be seen to be as fallacious when applied to the latter as if it were made to the former case. As regards the scientific results, we have seen that from the one post, extracted at haphazard from the roof of the bungalow, no less than ten different species of insects were taken, and of these it has been possible to identify, from the British Museum collections, but three. Of the remaining seven, one has already been named for me by a specialist on the particular family to which it belongs, whilst the other six have been referred to the genera in the families under which they come and the dictum of the experts in these various families must be awaited as to their future cognomens. It will therefore be conceded, I think, that the scientific portion of the investigation is not unimportant. With reference to the economic results attained from the study, we see that out of the ten species of insects discovered the operations of seven of them are in the nature of a service to

man. The other three wood-borers are his enemies. Now bostrichids of this kind do not infest green living trees, nor will they attack fresh-cut posts immediately after felling. As soon, however, as the sap has begun to dry off a little from the post the bostrichids make their appearance and commence boring into the wood for egg-laying purposes. It is immaterial, in the case of these beetles, whether the pole is barked or not, as it is the wood, and not the bast layer, which they require. It is during the drying stage therefore, whilst chemical changes are taking place in the wood, that our post requires protection, and, although the matter is at present, I believe, little understood (I write subject to correction, as I feel that here I am off my own course), if the posts are kept in water after being cut whilst these changes in their interiors are taking place their liability to attack by bostrichid beetles is apparently enormously decreased. My studies in this matter, as far as they have at present been carried, lead me to believe that this is not infrequently an undoubted fact, both in the case of wood and bamboos.

Observations on the methods and practices of that species of the genus *Homo*—surely the cutest and wiliest of men—the native Indian contractor, have led me to the conclusion that poles intended for use in his own house, or for sale to those of his friends who know, are placed under water as soon as possible after being cut, whereas those to be sold to the Sahib log, Officials of the great railways and other public departments, &c., purchasing such materials, are left unprotected to the tender mercies of our minute but devastating insect foes. The reason is sufficiently obvious. Although he knows nothing of Nature's laws, nothing of the struggle for existence daily taking place amongst all the inhabitants of the world, and analagous interesting questions, our wily friend is aware that the insects are almost certain to come provided his posts when cut are left in the open unprotected. He is also perfectly cognisant of the fact that the more intense the attack, *i.e.*, the greater the number of beetles present, the sooner will the infested posts require replacing, and not those posts alone but also their companions, which if unaffected before, will become attacked in turn from the infested ones.

“Worm eaten posts require replacing, and in the case of thatched bungalows the expense of a new roof is generally the result, and this several years before it would have been otherwise required.

The contractor, if questioned, says that posts never last longer in the country, and he probably instances several other roofs fitted with similar poles—supplied by himself; the Official, or owner, attributes the reason to the climate or, seeing the holes, to white ants. In the greater number of instances neither are right, but the contractor could give the correct answer.

Those who have followed me to this point will, I hope, agree that even from a riddled post some interesting natural history

facts are to be obtained. It is ever thus in Nature. In most unlikely quarters and from most uninteresting-looking objects she not infrequently produces her greatest surprises, and a close observation and study of her methods, even in what appear most trivial matters, will lead the enquirer often to the most startling discoveries.

III.-OFFICIAL PAPERS AND INTELLIGENCE.

Making Hay by Departmental Agency in Madras.

GOVERNMENT OF MADRAS.

READ the following Proceedings of the Board of Revenue (Land Revenue), Forest No. 60, dated 13th February, 1902:—

Read Endorsement No. 1217, by Mr. C. E. Brasier, Conservator of Forests, M. circle, dated 28th October 1901.

..... I believe more permanent good would arise if District Forest Officers were given a free hand to expend on cutting and storing fodder in any working circle in any year, an amount equivalent to the amount of revenue collected from cut grass in the said working circle during the previous year, such fodder being kept stored and sold during the ensuing hot season at such rates as the ryots could conveniently pay, taking into consideration also the quantity and quality of the hay available.

In G.O. No. 569, Revenue, dated 13th July 1897, paragraph 12, the duties of District Forest Officers are laid down.

I submit that the orders here referred to are not sufficiently definite to permit District Forest Officers incurring expenditure in cutting grass and storing it in the form of hay. District Forest Officers are therefore naturally cautious in doing so. If, however, a general order was issued on the lines sketched out above, some money would at least be available annually to carry on experiments in this direction, which might go far to eventually introduce the custom of storing fodder in the form of hay. I feel sure that

this custom will not be generally introduced unless money is expended in this direction, not alone for one year, but for a series of years. No profit should be looked for at first, and probably in many cases a loss would ensue, but if in the end the ryots took to making hay and storing it for themselves, or if the operations of the department were carried on on a really large scale without loss, we should be sufficiently rewarded, and I believe such operations would go far to popularize the department generally, which it should always be our aim and object to do.

Resolution.—In its Proceedings read again above the Board requested the Collectors of those districts* which are most subject to scarcity and famine to report through Conservators on the desirability of permitting the free removal of fodder grass from reserved forests at all times instead of during famine only as at present. The majority of the officers whose opinions have been received are averse from the grant of any permanent concession in this direction, and the Board is, on the whole, disposed to agree with them. Under the existing practice, however, Collectors must obtain the previous sanction of the Board of Revenue before permitting ryots to cut and remove grass free of charge from reserved forests; and this procedure not infrequently involves delay. The Board accordingly resolves in future to leave it to the discretion of the Collectors themselves to grant the concession as soon as the necessity for doing so arises. The privilege should be restricted to removals of fodder grass—not grass for thatching—by head-loads or by bandy loads, as may be deemed desirable, for limited periods in localities where there is demand owing to scarcity. Collectors should carefully watch the result of the concession and give the ryots distinctly to understand that it will be cancelled if at any time abused, and withdrawn if Government should itself require the fodder-producing area for hay-making operations.

2. In this connection the attention of all Collectors is invited to the standing instructions of Government in paragraph 12 of its order communicated with Board's Proceedings, Forest No. 351, dated 17th August 1897, and to the remarks of Mr. Brasier in his endorsement of the 28th October 1901 read above. The Board would be glad if, as suggested by Mr. Brasier, the making of hay were undertaken departmentally at such cost as Conservators and Collectors might think desirable, for a series of years in suitable localities in all districts, with a view to sale to the neighbouring ryots at reasonable prices, but not necessarily at a profit to the department. Such a system may be adopted either irrespectively of or in combination with any action taken with reference to Board's Proceedings, Forests No. 10, dated 4th January 1902, and might be of practical value in enabling the

* Kurnool. Bellary.	Anantapur. Cuddapah.	North Arcot. Chingleput.
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department to render immediate assistance on the outbreak of famine, and more particularly would serve as an object lesson to the ryots, to induce them to make hay and store it for consumption by their own cattle. In regard to the season for and method of making and storing hay, instructions will shortly be communicated.

All action taken in each district in the direction here indicated should be carefully noted in the administration report.

(True Extract.)

(Sd.) LIONEL DAVIDSON,

Secretary.

V-SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

By F. FINN, B.A., F.Z.S.

CHAPTER III.

TRAGOPANS, MONAULS, &C.

(Continued from p. 282.)

WE now come to the large and often long-tailed game-birds, commonly known as pheasants, to which may be referred eleven

genera, containing more than a score of species between them. To distinguish the cocks is quite easy, but the hens, being dull coloured, are less readily recognized, though any one who will observe carefully enough will be able to refer any hen pheasant to her proper group also, as there are always some points she shares with her mate.

In three genera the tail is *short* in both sexes, not being longer than the wing even in the cocks, and being shorter in the hens. In this respect they approach the partridges, but they are never less than about eighteen inches long, which is much bigger than any partridge except the great Ramchukors or snow-cocks. And in these there is a difference of three inches between the length of the wing and tail; whereas in these short-tailed pheasants the wing never exceeds the tail by so much as this.

These genera are the Tragopans, Monauls, and the Blood-Pheasants, which are easily distinguished from any others of the family.

The *Blood-Pheasant* is only about eighteen inches long, with very long, soft plumage and bright, red legs.

The *Monauls* (two species) are large birds, two feet long or more, with unusually large bills for game-birds, and short legs; the bill from gape to tip is about two-thirds the length of the shank.

The *Tragopans* (three species) are also large, about two feet long; but their bills are remarkably small, and their legs rather long, the bill being less than half the length of the shank.

In five genera the tail is distinctly longer than the wing, even in the hen, and very long indeed in the cock, this being the typical pheasant shape of tail, the centre feathers much the longest. These groups are easily made out.

The *Argus* has a bare head and the primary quills distinctly shorter than the secondaries, which more than cover them.

The *Peacock Pheasant* has a long broad tail with rounded tips to the feathers.

The *Typical Pheasants* (two species), have long tails with pointed tips to the feathers; the males have a bare red skin round the eye.

The *Cheer Pheasant* has a very long pointed tail and a crest, with a red skin round the eye in both sexes.

The *Amherst Pheasant* has a long pointed tail and a pale blue or green skin round the eye in both sexes, with a ruff in the male.

There remain three genera with tails of *medium* length, taking males and females together; the tail being about as long as the wing or shorter in the latter, and rather longer in the former, though never as extravagantly long as in the last group.

The tail is, even in the short tailed hens, much graduated, with the outside pair of feathers only half as long as the middle ones, which is not the case in the short-tailed pheasants alluded to above whose tails are merely rounded. Of this section:—

The *Koklass Pheasants* (two species) are distinguished by having the face feathered all over, and most of their plumage pointed tipped.

The *Fire-back* has, in both sexes, a short folded tail, much like a common hen's, and a bare bright blue face.

The *Kaleges* (about half-a-dozen species) have crests in both sexes, and also a bare red face, with tails, long or short, folded like a fowl's. The exact number of species in this group is uncertain, and the length of the tail varies in the cocks, but as a whole they are very recognizable.

To discuss the short-tailed genera first; the Tragopans, in addition to their large size, small bills, and rounded shortish tails, are notable for their long, slender toes and intricately mottled plumage. The tail is carried low, and is inclined to fold.

In the cocks this is always more or less mixed with red and speckled with light spots; they also have a full crest, and fleshy horns and a dewlap, most developed in the breeding season and expansible. The dewlap at most times is a mere fold of skin along the throat, and the horns lie concealed in the crest. But when the bird faces the female to show off, the horns elongate themselves and the dewlap comes down and spreads out into a bib or apron, showing the most brilliant colours. The cock also shows off by slanting himself over, like a common fowl.

In most male birds of this genus the face is bare, and they are provided with spurs. The colouration of this sex is very complicated and beautiful, but it is not necessary to describe it fully, as the different species are readily recognizable. The hens have no fleshy appendages or crest, and are feathered up to the eyes; they have shorter tails than the cocks, and no spurs. Their plumage is a very intricate, pepper and salt mixture, a great deal easier to recognize than to describe.

Tragopans inhabit hill forest at a high elevation, and are great skulkers, avoiding observation as much as possible. They spend a great deal of their time in trees, feeding on leaves and berries to a very large extent. From the observations of Mr. St. Quintin, who has recently been studying the breeding habits of the Chinese Buff Tragopan in confinement, it appears possible that these birds may occasionally even nest in trees; ordinarily they breed on the ground like other pheasants. The young, according to the gentleman above quoted, take to perching very early, and are highly insectivorous. Thus they would tend to offset any harm the adults might do to young growth.

The note of the cock Tragopans is most remarkable, being compared to a bleat or a bellow rather than a crow, but they are silent birds as a rule, except in the breeding season. They are not easy to shoot, and sometimes rather poor eating, but for their peculiar beauty of plumage they are unrivalled. Only five species are known, all Indian or Chinese. Our birds are often called Argus Pheasants, but the real Argus is a very different bird.

THE CRIMSON TRAGOPAN.

Tragopan satyra, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 99. Native names:—*Lungi*, Hind. in Garhwal and Kumaun; *Mondal* in Nepal; *Omo*, *Bap*, Bhutia; *Tar-rhyak*, Lepcha.

In this species the male's face and throat are thinly feathered, the general plumage is rich red on the neck and below, and mottled black and brown above, sprinkled nearly all over with round white spots edged with black; the head and tail are black, with a red band round the back of the former; the bend of the wing is also red, and there are red patches on the mottled brown plumage of the rest of the wing and the rump.

The bill is black brown, the horns sky-blue, and the skin of the face and throat rich deep blue, the bib being patched with scarlet when expanded; the eyes are dark and the legs flesh-coloured.

The hen is of a rich brown, paler below, grizzled and mixed with black and buff. Her beak is dark horn-colour, and her legs fleshy grey.

Young birds are like the hen, but distinctly streaked with buff; young cocks assume male plumage very gradually.

The male is well over two feet long, with wing and tail each about ten inches, and shank over three, and twice as long as the bill. The hen is under two feet, with the tail shorter than the wing.

This species, one of the most richly-coloured birds in existence, inhabits the Himalayas from Garhwal to Bhootan, ranging according to season from six to twelve thousand feet in elevation. It breeds in May, laying eggs much like large hen's eggs, white, with pale, dull lilac markings, and about two-and-a-half inches long. The males are killed in considerable numbers for their skins, the traffic in which wants very sharply looking after in order that the species may have a fair chance.

Very close to our East Assam frontier occurs a species which may possibly ere long have to be reckoned as an Indian bird. This is the grey-spotted Tragopan of China (*Tragopan temminckii*), which much resembles our species just described. The cock, however, differs strikingly in having the light spots of the plumage larger, not edged with black, and pale grey instead of white, while the red ground is not so bright.

THE BLACK OR WESTERN TRAGOPAN.

Tragopan melanocephalus, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 101. Native names:—*Jewar*, *Jowar*, in Garhwal; *Jaghi*, *Jajhi*, Bashahr; *Sing-monai*, Hindi in N.-W. Himalayas; *Jigurana* (the cock), *Bodal* (the hen), Kulu, Mandi, and Suket; *Falgur*, Chamba.

This bird has a longer crest than the Crimson Tragopan, and is a little larger, with a slightly shorter tail; the face of the

cock is also bare. His prevailing colour is black, grizzled with buff above, and spotted with white both there and below. The neck is red, brightest in front; and the top of the crest and bend of the wing are also red; there is also a certain admixture of red below the breast. The bill is blackish, eyes brown, legs flesh-coloured, and horns blue as usual; but the bare face is bright red, and the dewlap purple in the middle, and showing spots of blue and flesh-colour at the sides.

The hen is of a grizzled brown, much greyer in tone than that of the Crimson Tragopan hen, and with the pale spots below—which are white, not buff—better defined and dark-bordered. Her feet are grey.

This bird inhabits the North-Western Himalayas from Garhwal to Hazara. It nowhere meets the crimson species, their respective limits being separated by a distance of about four days' march. It keeps near the snow in summer, descending lower in winter. The eggs, six in number, of a pale buff minutely freckled, were taken in Hazara in May by Captain Lantour. They seem to be slightly smaller than those of the red species.

THE GREY-BREASTED OF ASSAM TRAGOPAN.

Tragopan blythii, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 102. Native names:—*Hur-huria Sansaria*, Assam; *Gun*, Angami Naga; *Chingtho*, Kuki.

This is smaller than the other Indian species, and has a shorter crest tail. The male has a black head, with red eye-brows meeting behind, the neck and bend of the wing red as usual, and the underparts below the breast smoky grey; the upper plumage is black mottled with buff and spotted with white and red; the tail is black. The bare face and throat are yellow, running into green below; the bill and eyes dark, the horns blue, and the feet flesh-coloured as in other male Tragopans.

The hen is of the usual hen Tragopan grizzle, less grey in tone than the black Tragopan hen; from the hen of the crimson species she may be distinguished by having a greater proportion of black above, and being mottled with dirty cream colour instead of buff below, the upper and under surface being thus more strongly contrasted than in the other. These hen Tragopans are easy enough to distinguish on comparison, but as no two inhabit the same tract, this will rarely be necessary.

The present species inhabits Manipur and the Naga Hills south of Assam, ranging from five to ten thousand feet according to season, like the other species. It has also been known to occur in the Daffa Hills north of Assam. It feeds chiefly on berries and affects high oak forest. Its breeding in the wild state is not known, but an egg laid in confinement was buff finely speckled with reddish brown.

The only other species of Tragopan known is the Buff Tragopan (*Tragornis caboti*) of China, which I mentioned above. In this the cock is all buff below and heavily spotted with buff above, and has the bare face red. The hen is much like that of the Crimson Tragopan, but considerably smaller. This species might very well be introduced to fill the gap between the black and crimson forms.

VI.-EXTRACTS, NOTES AND QUERIES.

Report on Specimens of East Indian Walnut.

(By MR. HERBERT STONE, F.L.S., F.R.C.I.)

THE following report of the examination of specimens of East Indian walnut has recently been made by Mr. Herbert Stone, one of the Imperial Institute expert referees on timbers. In his report Mr. Stone says:—I have carefully examined and tried the sample slabs of *Albizia lebbek*, or East Indian walnut, otherwise known as "koko," and am favourably impressed with the wood, as it is fully equal to the American black walnut (*Juglans nigra*) which is now so largely used in England, and I think it would compete on equal terms with that wood. It is certainly heavier and varies considerably, amongst the 13 specimens one or two being rather heavier than is desirable for a furniture wood. It possesses a good figure, which runs curly at times in which case the appearance is very fine, and though not possessing much lustre when straight-grained, it has a "watered" appearance when curly in the grain. Taking plain and choice specimens together it shows about the same range of figure as the above-mentioned American walnut.

I make my comparison with this wood, as it is the one whose place it must occupy, for I do not think it would compete with English or Italian walnut (*Juglans regia*). The mechanical tests I have applied are sawing, planing, turning by power and polishing by hand. I find that it comes up to a better surface, with rather less trouble, than the American wood, and can be worked as fast and with the same ease. In finishing it requires less preparation by means of glass-paper, as the wood is denser, but as the grain is very coarse, it requires much filling, and the pores are lined with a quantity of soft tissue which absorbs much polish and hence occupies much time. I consider that as good a finish can be obtained in about the same time as with the black walnut. I do not doubt that a market can be found for East Indian walnut in England, and I consider that ordinary straight grained sound boards and planks should be worth 2s. 6d. per cubic foot at London or Liverpool. Choice logs would probably fetch higher prices up to 4s. 6d. per cubic foot. It is as well to mention that until the wood becomes known on the English market remunerative prices should not be looked for. A new wood is nearly always imported for a time at a loss.

The specimens examined were:—

I. I. No.	Indian No.	Whence received.	Remark.
5526	2914	Satara, Bombay ...	Rather a poor specimen, poor in colour and the hardest of the series. Works well.
5525	2913	Haveli, Poona ...	A good specimen, although from a very small tree; very fair colour; works better than the average.
5889	3277	Surat, Bombay, marked "Maghrech Bilimore."	Planes like American walnut and well. Poor in colour, streaky and of little value.
5505	2893	North Kanara, Bombay.	<i>The best specimen</i> , rather redder in colour, nice straight grain; works excellently. A fine piece of wood.
6129	3512	West Khandesh, Bombay	Works well, rather hard, good colour, rather streaky, of a rather purplish cast.
5504A	2892A	South Arcot, Madras ...	Works well, rather streaky moderately good only; hard.
5504B	2892B	Do.	A fine piece of curly, figured wood, but heavy and the hardest of all; good colour.
5506	2894	Tellicherry, Madras ...	A fair specimen, but good and of fair colour. Works well.
6127	3509	Ganjam, Madras ...	A good plank of good colour, even grain, very heavy. Works well.
4938	2656	Tenasserim, Burma ...	A poor plank of inferior colour, streaky; works well but with an unpleasant, sneeze-provoking dust.
6275	4789	Mandalay, Burma, marked "Dharwar."	A poor specimen, rather light indifferent colour, works badly. Probably immature and a little tainted with decay.
4937	2655	Thayetmyo, Burma ...	A good specimen of fair colour, coarse in the grain; works well.
6126	3508	Minbu, Burma ...	A quite useless plant, badly tainted, defective and of extremely bad colour. Works well notwithstanding.

The Snow Leopard.

THE intention of the Government to prescribe the skin of the snow leopard as the full dress saddlecloth for the Imperial Cadet seems to have attracted some attention among sportsmen at home as well as in this country. The proposition was certainly made at a rather unfortunate time, for during the last year or so the question of game preservation in India has been brought very prominently to the front, and any step which might even appear to make for the reduction of rare animals was sure to be deprecated. The Marquis of Ailesbury, we observe, asked the question in the Lords, of which he had given notice concerning this item of the Imperial Cadet Corps Equipment, and was informed by Lord Raglan, who spoke for the military authorities, that the discretion of His Excellency would not be interfered with. The Marquis had laid stress on the generally accepted view that *felis oncia* is not only rare, but "practically harmless," and Lord Raglan in his reply stated with regard to the rarity that there are only twenty officers of the I.C.C. for whom only we infer snow leopard skins will be required, and with regard to the character of the animal, "that it is an open question whether these leopards are as harmless as they are supposed to be." That the Imperial Government purchased a number of skins which happened to be on the market at the time, and that no snow leopards were killed to supply the demand is not perhaps very germane to the point, and if only twenty skins are required from time to time, there is no practical reason for protesting, as that quantity will not cause a demand and create a stimulus to destroy the animal.

The matter has, however, had the effect of bringing the character and conduct of the snow leopard before us for consideration. He is generally accounted rare, but perhaps it were more accurate to regard him as rarely seen; of wary and also nocturnal habit, he does not lend himself to observation; and it is noteworthy that his name is but seldom mentioned by those sportsmen who record their experiences of Himalayan sport. General MacIntyre, in *Hindu Koh*, refers to an occasion on which a snow leopard made free with the carcasses of burhel that had had to be left out all night, and expresses his annoyance that his shikari had not the sense to leave one of the carcasses as a bait, and so deprived him of the chance of "a shot at a rather rare animal I was most anxious to kill." Among more recent writers the only one who occurs to us as having made special reference to the animal is Mr. H. Z. Darrah, I.C.S., in his *Sport in the Highlands of Cashmere* (1898). He sighted one of the species one morning when he had started at dawn, and as it proved to have killed a bullock two days before, he was fortunate enough to get a shot at it that night; his chance in the dark was a poor one and he missed, much to his disgust, "for a chance at a snow leopard is very rare." That the animal does prey largely on hill

game of course nobody thinks of questioning; and that he takes severe toll of the cattle when in summer the hill people drive their flocks and herds high up to feed, also cannot be denied.

A reference to the saddlecloth question in Parliament has drawn a vigorous attack on the character of the animal from Captain W. W. Lee, who writes to *The Field* from Karpa Tal, Naini Tal. Captain Lee is a sportsman who has spent 46 years in this country, and his opinion is obviously entitled to the greatest weight. After condemning the Marquis of Ailesbury's question as absurd, he pronounces the snow leopard the most pestilent vermin in the whole of the Himalayas, with the possible exception of the wild dog, which, hunting in packs, "is about as bad." Captain Lee refers the presumed rarity of the beast to the fact that its habitat is usually remote and inaccessible, and that it does not pay the native skin hunter to devote attention to him. He says that owing to the difficulties attending their pursuit "they flourish to their heart's content on the confines of the snows, and countless numbers of ibex, markhor and tahr fall victims to them, as well as any number of domestic sheep and goats belonging to the traders and herdsmen of the hills." This is a serious indictment, and thoroughly justified. Snow leopards easily exist in considerable numbers in suitable regions without attracting much attention from the chance sportsman, who passes through the district on his way to a shooting ground; the temporary villages of the pastoral hill people are not abodes of bliss to the European, with a skin acceptable to the familiar vermin, which are only too plentiful in such places, and the white man does not, as a rule, make very strenuous endeavours to win the confidence of these semi-nomads beyond making enquiries by deputy concerning the whereabouts of markhor or whatever prey he may have in view. The visitor and the native temporary resident, in short, do not come into very intimate contact, and the former therefore hears less than he might otherwise do. The misdeeds of the snow leopard are thus not brought to his notice as are the visitations of the leopard in the plains, where the sportsman's tastes are better understood of the native mind, and as before remarked, the nocturnal habit of the beast is a great protection from the attention of the sportsman who has been tramping the hills the whole day. Captain Lee regrets that "there is not the slightest fear of their being extirpated," a result which he says he should, as an old sportsman, rejoice to witness, and in this we concur. He would count it a blessing were every trooper in India, European and native, ordered to ride on a snow leopard skin saddlecloth with the sole object of reducing their numbers. We give this prominence to Captain Lee's views as they appear so much at variance with those entertained by certain sportsmen, and

because he, so far as our knowledge goes, is the first man to publicly stamp the snow leopard as a downright bad character whose misdemeanours would justify his extermination.

—*Indian Field.*

The Timber Resources of the Australian Commonwealth.

EXTRACTS FROM A PAPER BY EDWARD T. SCAMMELL.

THE subject upon which I have the honour to address you is one of considerable importance to the Australian Commonwealth and to the United Kingdom. It is important to Australia, in view of the fact that her timbers are a valuable, and should prove a permanent asset, and to the United Kingdom—(1) because of her desire to promote the commercial prosperity of her Dependencies, and (2) because her timber markets are always open to suitable timbers which can be offered on terms which may render business possible and profitable.

In dealing with the timber resources of Australia, it is not my intention to give you a detailed account of them, for such an undertaking, however interesting to the botanist, would be, for practical purposes, useless. The object I have in view is to serve, as far as possible, the commercial interests of the Australian Commonwealth, by demonstrating the claims of Australian timber to the favourable consideration of municipal, railway, and marine engineers, architects, builders, and cabinet and art workers, and to give only such particulars as may be serviceable to that end.

I am glad to have the opportunity of performing this duty, both as a member of this Society and as one who, for a number of years, has interested himself in Australian affairs, and who now has the honour to represent one of the States whose timber resources will be passed under review. So far as this Society is concerned, as it seeks the commercial as well as the artistic and scientific interests of its members and of the public at large, it is quite in accordance with its principles and scope that a subject of this nature should be treated here.

It will be remembered that last year a very important paper was read in this hall by Professor Schlich on "The World's Timber Supply," which was followed by a discussion of high value. That paper had, evidently, some weight with the British Government, for, during the last few weeks, a committee has been formed, under the auspices of the Board of Agriculture, "to enquire into and to report as to the present position and future prospects of forestry in Great Britain." I trust that that committee will also give at least passing attention to the question of forestry

in our Colonies in order to assist the movement there—a movement the value of which to the Empire at large it would be difficult to over-estimate.

In 1897, a "Commission on State Forests and Timber Reserves" was appointed by the Parliament of Victoria. That Commission concluded its labours in March, 1901, after taking a mass of evidence and making a most careful examination of the whole subject. In the 14th and final report, issued a few months ago, a copy of which I have had the opportunity, through the courtesy of the Victorian Agency, of studying, an interesting account is given of the forest resources of Australia from which I propose borrowing my introduction. The report says:—

The true forest region of Australia is almost entirely coastal; *that is to say*, the most luxurious tree growth is confined to the mountain and hill ranges, which to a large extent follow at a moderate distance the trend of the coast, and to the tablelands and foothills which stretch from these toward the shore line. Where, however, the ranges approach closely to the ocean, as is the case with the Darling hills in Western Australia, the forest belt may extend beyond the water-shed some distance inland, its limits being clearly marked by a greater rainfall and a more temperate climate. Thus, in Western Australia, the great belt of jarrah, some 350 miles in length by 50 to 100 in breadth, which stretches eastward from the Darling Ranges, has two distinct but narrow belts of tuart and red gum between it and the coast. Within the extensive tract of jarrah, in the extreme south-west of the colony, is the main karri belt, stretching from Cape Hamelin to Torbay, and lying between 115° and 118° East Longitude, and 34° and 35° South Latitude. This region in which the jarrah, karri, tuart, and red gum are the dominant trees, has an annual rainfall varying from 35 to 40 inches. In somewhat drier districts stretching eastward of the jarrah belt, there is a fairly wide strip of white gum, enclosing a narrower belt of York gum, which, as regards its northern and southern limits, is almost coterminous with the jarrah. Eastward of this again the arid region, where the annual rainfall is some 14 inches and under, is entered, and the forest rapidly dwindles, changing first to a poorer growth of white gum, until, in the sandy wastes of the goldfields region, the vegetation changes to brush, scrub, and dwarf trees, the latter being chiefly the eucalypts, locally known as salmon, morrel, and gimlet gums, with some belts of pine at intervals. Along the shores of the Great Australian Bight the vegetation is scanty and inferior, consisting chiefly of stunted eucalypts of the kinds of the last-mentioned, casuarinas, the cyclopis wattle, and grass tree. It is not till the province of South Australia is entered that any elevated country is met with, and there the Flinders, Gawlers, and Mount Lofty Ranges are merely chains of hills of inconsiderable extent. In these ranges the timber consists of the sugar gum

the white ironbark, two varieties of stringy bark, the white or manna gum she-oak, and in the valleys and ravines red gum. It is, however, when the western part of Victoria is reached that the commencement of the great mountain system, as well as forest region, of Eastern Australia is seen.

The forest region of Southern Victoria corresponds to a considerable extent with that of Tasmania, the principal eucalypts being blue gum, spotted gum, messmate, stringy bark, silver-top ironbark and mountain ash, with evergreen beech and acacias, such as the blackwood and several species of wattle. In the northern part of the colony the trees are of a kind common to New South Wales. Thus the level country bordering the River Murray and its southern tributaries is the home of the flooded variety of red gum, intermixed with greybox and (near the Murray) cypress pine, while the undulating land and low Silurian ridges between that river and the mountains are covered with two species of ironbark, stringy bark, and several kinds of box. In New South Wales and Queensland, between the Dividing Range and the Pacific, are found some of the finest belts of forest on the Continent. Among eucalypts are several varieties of ironbark, tallwood, black-butt, grey gum, spotted gum, turpentine, forest red gum, and red mahogany; among conifers the Moreton Bay, brown, and Bunya Bunya pines; while among the brush timbers of fine grain are red cedar, rosewood, redbean, blackbean, beech, silky oak, beef-wood, and tulip. Westward of the ranges in New South Wales, where the table land sinks down to undulating country and vast plains, through which the tributaries of the Murray make their way, the vegetation changes to scrub and open forests, consisting of eucalypts, such as red gum along the watercourses, with several varieties of box, cypress, and other pines and wattles. Further inland again the timber becomes more sparse, being chiefly cypress pine, stunted eucalypts, and casuarinas, with extensive areas of mallee scrub. In Queensland a large portion of the country west of the Divide is an extensive plateau running into great plains, well-watered and covered with rich grasses, but with little timber. Towards the centre of the continent, where the land gradually falls to a vast shallow basin with low hill ridges at intervals on its rim, and wide expanses of plain country with short watercourses losing themselves in the desert, the tree growth is very scanty, consisting of stunted eucalypts, such as the gimletgum (*E. salubris*, and *E. microtheca*, the desert she-oak acacias, and mallee.

FOREST AREAS.

The following table, showing the extent of country estimated to be under forest in the six States of the Australian Common-

wealth, is based on special returns given to the Victorian Royal Commission by the several Governments:—

State.	Area in Sq. Miles.	Area in Acres.	Forest Area in Acres.
Queensland ...	668,497	427,838,080	40,000,000*
New South Wales ...	310,372	198,638,080	20,000,000
Victoria ...	87,884	56,245,760	11,797,000†
South Australia ...	903,690	578,361,600	3,840,000
West Australia ...	975,920	624,588,800	97,920,000‡
Tasmania ...	26,215	16,778,000	11,000,000
	2,972,578	1,902,450,320	181,557,000

In the second part of my paper, I propose to deal as briefly as possible with the question—*What are the prospects of the timber trade of the Australian Commonwealth with the United Kingdom?*

The value of the total British imports of hewn and sawn timber for 1900, according to the Board of Trade Returns, amounted to £29,350,638. Of this enormous sum the amount contributed by all the States of the Commonwealth was £302,109. The amount, however, as given under the head of Exports, "Timber—domestic produce and manufactured," in the States' Returns for 1900 is £194,816, divided as follows:—Western Australia, £187,464; New South Wales, £6,637; Queensland, £675; Victoria £40, South Australia and Tasmania, *nil*. Even taking the higher figure, the contribution of the Australian Commonwealth towards the total British imports of 1900 was ridiculously small. The question therefore arises, seeing the great market which this country affords and the considerable timber resources of Australia, is it not possible to alter this state of things for the better?

I am fully aware that there is one difficulty of immense importance—the *distance of Australia from the Mother country* and the consequent cost of transit. But, surely in these days of shipping combination, with increased economic management, one would venture to think that some arrangement might be made to cheapen freights, so as to make it possible for Australia to compete with other countries for the supply of high class, if not common, timbers. This is a matter, however, for the considera-

* Marketable timber. Probably one-third of the State may be said to be well covered with timber, of which a large quantity has a local value for building and other purposes.

† Reserves and proposed reserves of all kinds, 5,525,000 acres; inaccessible country, 6,272,000 acres.

‡ About 20,400,000 acres are covered with marketable timber, while the remainder bears trees useful for local purposes (inferior timber and brushwood).

tion of shipping companies, and, it may be, the various State Governments, as well as the millowners of Australia, and the timber companies operating with Australian timbers.

But there are some other questions relating to *methods of production and of business in Australia*, to which I think attention should be called.

Sir William Thistelton Dyer, in the discussion on Professor Schlich's paper on "The World's Timber Supply," is reported to have said "he was not very hopeful that Australasia would ever do much to aid the timber supply." May we ask, why not? The timber is there, and of its suitability for many classes of work there can be no question. Is it because the exporters or the producers do not quite understand the requirements of the home market, and so do not take sufficient care in preparing their woods for it, or in arranging for a continuous supply at such prices and on such terms as would render trade possible?

I fear that there may be something in this question, as there appears to prevail an opinion among some of the producers in Australia that the English market will or should take just what they like to send it. The timber may be immature, unseasoned, and defective in other respects. It may have been cut from trees grown in varying soils and under dissimilar conditions. And the whole may be sent in one consignment without being marked or graded in any way. In this case, the importer, unless he be skilled in this species of timber and be able to examine his consignment in detail, would be quite unable to determine its real value, and would have to wait until the user had determined it for him. It would not therefore be surprising, if disappointment and failure ensued, and the prospective trade be ruined. Now if this be so to any extent, there is clearly need of improvement, if any effective business, on a large scale, is to be done.

Care, also, appears to be required in what the Victorian Commission calls "*working practice*," in the *Forests themselves*. In an instructive paper, by the late Mr. G. S. Perrin, F.L.S., read before the Royal Victorian Institute of Architects, Melbourne, in 1893, at the time he held the position of Conservator of Forests of Victoria, he said, "I would point out to all interested and strongly urge the importance of placing their timbers in the best possible condition in the hands of their customers on the other side of the water." In order to do this, he suggests among other things: (1) the ring-barking of all trees intended for sawing, at least three months prior to placing on the bench; (2) the cessation on the system of cutting timber at the mills in a perfectly green state; (3) the stoppage of the system of selection of young and immature trees, such trees being invariably filled with sap and half-formed wood, yielding quickly to decay; and (4) that care should be taken that none but the best trees are selected and that the sapwood and heart wood be carefully excluded. In treating of ring-barking, he says, this is

important "as the tree in its perpendicular position is more rapidly drained of its sap and natural juices when once the bark is cut through into the wood." He condemns the practice of "allowing the log to remain on the ground, in a horizontal position, when the sap and the acids contained in the trunk percolate into the tissues and must remain there decomposing and gradually rotting the log." "This question," he continues, "cannot be too strongly impressed upon mill-owners." He admits that it is not easy to fix the time for ring-barking on any hard and fast lines, because of differing local conditions. But it should be done when the sap is down.

What effect the publication of these views may have had in Australia, I am not in a position to say, but I have recently read a statement made by a forester of Western Australia, who claims a life-long experience in timber work, whose opinions certainly are not in harmony with those of Mr. Perrin. He speaks of the sap and the gum in jarrah and other eucalypts as being "the life blood" of the tree, and contends that the tree should be cut when the sap is up, because then it retains all its preserving qualities! When the sap is down, the tree is in a semi-dead state, and its lasting qualities are lessened! He therefore condemns ring-barking. Apparently the engineer, who thinks that sap should be expelled, has made a mistake. For if, according to this opinion, you got rid of the sap, you lower the quality of the wood.

Another writer on the subject of Western Australian woods, speaking with authority respecting the gum (kino) in jarrah, and rightly arguing as to the value of this substance, complains that the foreign buyer of this timber often rejects it because it shows "gum veins," whereas these veins show the excellence of the timber in which they are found. While this may be perfectly true as to the quality of the other parts of the wood, it is not an easy thing to convince an engineer that gum veins are satisfactory. On this point a gentleman, who understands the trade thoroughly, very pertinently says that while these veins may be no detriment "to rough work, such as piles, sleepers, and the like, which will stand gum patches in moderation, they will not do in high class machine worked boards or scantlings." In his judgment, which is confirmed by the opinion of others, "where gum is concentrated in large patches, the tree has bled from cause of injury probably," a fact that the expert to whom I refer, would readily admit. This, however, is the conclusion of the matter, "if," says my friend, "the superior merits of eucalyptus timber depends upon signs of gum, it will take a lot of selling in this country."

But as a further proof of the necessity of an improvement in the "working practice" to which I have referred, take another illustration. In the judgment of a municipal engineer of Queensland, who has written a paper on the subject, and

should therefore know something about it, to season Australian timbers properly, they should be immersed in water for 14 days to dissolve the sap and afterwards be allowed to dry in the sun! Such an opinion needs no comment.

I could submit a number of further proofs of the necessity of careful consideration of these matters, if required, but I will content myself with one concluding piece of evidence. A gentleman, who has had more years' experience in the timber trade than he cares to count, and who knows a good deal about Australian timbers, writing me on the subject of my paper, advises that the attention of those who are interested in the timber industry of Australia should be confined, for the present, to a few of the better known woods, such as Western Australian jarrah and karri; Victorian red gum, grey box, and forest mahogany; New South Wales blackbutt, tallow-wood, turpentine, and spotted gum; and Tasmanian blue gum and two or three other varieties. He then says, "I cannot too strongly warn intending shippers from sending supplies to the European markets unless carefully selected and prepared by an experienced man, well-versed in the requirements of such markets, as a carelessly selected and badly prepared shipment of a new species of wood not only entails most serious loss to the producer, but creates a prejudice against the wood itself, which will take years to remove, however good future shipments may be." He then furnishes an instance of this in regard to Tasmanian stringy bark, which he considers an excellent timber, if properly treated. He further says that he regards "ring-barking as advisable in all cases; and if scantlings are to be cut, it is essential. All the eucalypts are to a certain extent evergreens, but the growth is practically quiescent in the autumn and early spring, say from April to August. It is, therefore, during these months that the trees ought to be ring-barked, and they ought not to be felled for 15 or, in the case of large trees, 18 months afterwards. *On no account must the tree be felled whilst green, and allowed to dry on the ground.*" He holds that there is no such danger from forest fires, as some Australian foresters appear to think, if the trees be ring-barked, seeing that in many of the forests there is little undergrowth, while ring-barked trees of the nature of eucalypts cannot, in so short a time, be rendered "bone-dry." He is of opinion that all timbers to be used for piles should have the heart "boxed," and that the trees chosen should be as small as is consistent with the dimensions of the piles required. He calls attention to the fact that, in a recent contract for piles, 90 ft. to 100 ft. long by 18 in. square, it was stipulated that the bottom of the pile, which of course is the top of the tree, should be without wane or rounded edges. This condition necessitated the selection of trees of immense diameter, some of which were past their prime, the heart wood near the butt being inclined to be "spongy." He considers that had some latitude been given

as to wane at the top, trees in their very prime condition could have been secured, labour and waste saved, and stronger piles would have been supplied. He concludes by saying that the best wood of Australian eucalypts is not near the heart, which is well-known by those who have any experience with this class of timber, and that, therefore, all scantlings should be clear of the pith by, at least, three or four inches, and that as wood invariably shakes in the direction of the medullary rays, and across the annular rings, all scantlings should be sawn on the quarter.

Some of these points are, of course, matters of common knowledge to those who are familiar with the trade. But they, with others relating to the methods of production and business, to which I have alluded elsewhere, are certainly worthy of careful attention.

In conclusion, I would respectfully submit—

First, that importers and users of timbers in Great Britain and Ireland should be prepared to give favourable consideration to the claims advanced on behalf of the woods of all British Dependencies, and should be willing, in order to encourage the trade of Greater Britain, to make some sacrifices, if necessary, for this purpose. Take, for example, our railway companies. It is well known that hard wood sleepers will far outlast soft wood, and that, indeed, for durability there is nothing like them. Should not these companies, therefore, be willing to consider the question of adopting these woods, even if the prime cost is greater to begin with, than the softer woods to which they have been accustomed? It has been suggested that it would be well for them to inquire into the advisability of doing away with "chairs" on their permanent way, in view of the fact that most of the Continental and all the Australian and American railways have done so to the alleged economical advantage of the system. Were such a course adopted, a considerable extension of the use of Australian sleepers would be likely to ensue.

Second, that the British Government should do its part to assist the development of trade within its own dominions, (1) by careful inquiry as to the timbers grown in Australasia, Canada, and other Dependencies of the Crown, suitable for its public works and for naval construction, and (2) in every case where such timbers can be economically employed, by specifying them. I have recently heard some strong things said about the action of the British Government in ordering railway sleepers for South African railways from Europe, when sleepers of a better class and at very moderate prices could have been obtained from Australia. It has been thought that, in view of the sacrifices which Australia has made on behalf of the Empire, she deserved a little better treatment.

Third, that the various States of the Australian Commonwealth, or better still the Federal Government, should concert

measures for (1) the conservation, management, and development of the forest resources of each State ; (2) the classification, naming, and testing of all timbers available for export ; (3) the provision of all necessary internal transit and other facilities, in order to assist millowners and others interested in the development of the timber industry in each State, and to encourage them to expend more capital upon it ; (4) the organisation of a Bureau in the city of London, where samples of Australian woods may be inspected, and where the fullest information in regard to all timbers available for export may be obtained.

As to the question of the conservation, management, and development of the forest resources of the various States, there is no doubt, if they are to become a permanent, not to say an immediate asset, the measures necessary must be adopted. On this point Professor Schlich, in his paper, said : " Surely the time has come, or rather it came some time ago, for a more vigorous forest policy, on sensible lines, throughout the Empire. Let us strive to introduce systematic forest management, more particularly into Canada and Australasia. The question is no doubt beset by great difficulty, but where there is a will there is also a way. Above all, let the selfgoverning Colonies consider the magnificent example which has been set them by India, where the preservation of the State forests has now been put on a safe basis, for the everlasting benefit of the people of the country and the Indian exchequer." I am glad to know that Dr. Schlich's idea is likely to be carried out in some measure. The able report of the Victorian Royal Commission refers to the action of the East Indian Government, and to the need of a similar course being adopted in Australasia. In other States, besides Victoria, the question of the forests is also receiving increased attention. Efforts are being made to check the lamentable destruction of valuable timber, which in the supposed interests of land settlement and agriculture has been going on for so many years, a destruction which has been characterised as unnecessary and even wanton. In this respect, we are all offenders, and offenders against light and knowledge. In 1878 Mr. Julian C. Rogers, the Secretary of the Surveyors' Institution, wrote a most informing paper on the subject of Colonial Timbers, which was adopted as a Government paper and circulated under Government authority. In that he said, " The returns exhibit, in a striking manner, the urgent need for some prompt and comprehensive action to stay the influences at work to destroy the indigenous forests which constitute in many instances, the principal natural riches of the Colonies. There is a tendency in newly settled countries to regard the timber as a mere encumbrance to the land, and as it generally occupies the most fertile soils, the finest timber is that first selected for destruction." Had the information given, and the advice tendered so long ago received the attention they deserved, the condition of the forest

resources of Australia and other British Dependencies would have been very different from what it is to-day.

As to the *classification, naming, and testing of timbers* available for export, the enumeration of the various trees with their diverse and confusing nomenclature, which has formed so large a part of this paper, the varying opinions prevalent as to the comparative strength of Australian timbers shown in the strangely contradictory tests that have been published, and the uncertainty in which the question of the supply of suitable timbers for export is involved, render this suggestion timely and necessary.

The same may be said of the *provision of internal facilities for the development of the timber industry of the various States*. Those who know anything of the difficulties with which the millowners of Australia have often to contend will heartily endorse this view.

As to the *establishment of a Bureau in the City of London*, I think it will be admitted that, while the display of Australian timbers at the Imperial Institute is an excellent thing from an educational point of view, neither that nor the supply of information at the disposal of the separate Agencies will so well meet the requirements of the trade, as the establishment of a central Bureau in the City, where samples of Australian timber can be inspected, and the most up-to-date information can be obtained by engineers and others, who are only waiting the opportunity to help forward the interests of Greater Britain.

These are matters which, in my judgment, are worthy our attention, and the attention of the Governments of the various States of the Australian Commonwealth, as by their adoption the permanent interests of the timber industries of those States would be promoted, and a large and profitable trade with the United Kingdom and the Continent of Europe be secured.

Dr. W. SCHLICH, C.I.E., writes :—Mr. Scammell's paper has brought an important matter before the members of the Society of Arts. As regards the forest question generally, and the timber supply of the Empire in particular, Canada and Australia demand our special attention. Mr. Scammell's objects are to show that considerable stocks of various useful timbers are available in Australia for export to this country and elsewhere, and to bring about a further development of the existing exports. While heartily wishing him success in the latter respect, I sincerely trust that the Governments of the several Australian Colonies will, without further delay, take the necessary measures so as to secure a permanency of the trade, and not be satisfied with a temporary development, followed by the ruin of the still existing forests.

From a general survey of the data at my disposal, it appears that only about 10 per cent. of the area of Australia are under

timber forests, and enough has been said and written to show that these are on the highway to ruin. "The Commission on State Forest and Timber Reserves," appointed by the Parliament of Victoria in 1897, clearly shows that the Australian States are still playing with the forest question. While the splendid forests of eucalypts and other trees are, in many cases, for temporary political reasons, allowed to be ruined, the Legislatures quiet their consciences by establishing puny plantations of exotic and indigenous trees. Surely they would do better to look after the existing forests, and thus perpetuate a supply of timber and other produce for home consumption and export. What is really wanted, and urgently wanted, is:—

1. To select in each State a sufficient area of permanent State forests, and to put them under a system of efficient protection and management, and
2. To remove these State forests from the vacillating influence of party politics, by rendering them inalienable, except for special and important reasons.

These measures need not for a moment interfere with the maintenance and further development of the timber trade, because the formation of State forests does not mean shutting them up. No doubt considerable areas have been leased away, but enough remains to carry out the policy indicated above.

Another point to which I should like to draw attention is the ridiculously small revenue which the Australian Government derive from this important State property. Taking for instance, Western Australia, it is said that the total forest area amounts to some 97,000,000 acres, of which about 20,000,000 acres are stocked with marketable timber. In 1899 the exports of timber were valued at £583,000, while the revenue paid into the State treasury amounted to £17,000. This is not the way to dispose of State property, which belongs to the community as a whole. Let everything possible be done to develop the trade in timber, but let the State have a fair share of the profit, wherewith to introduce a rational treatment of the forests and to insure their permanent yield capacity. Several of the Australian timbers are so valuable for a variety of purposes, that a steady demand is sure to arise and be kept up. As regards one class of utilisation, I am, however, somewhat doubtful. Great efforts have been made to convince people that jarrah and karri are the best timbers for street paving blocks, and in all probability they are. At the same time, I believe, that the solution of the question lies elsewhere. My personal opinion is, that as soon as motor cars of various sorts have seized upon the traffic in our towns, the Corporations will once more lay down asphalt, pure and simple, as the most suitable, and at the same time, the best paving material from a hygienic point of view.—*Journal of the Society of Arts.*

The Forests of Russia.

THE gradual deforestation of Russia is attracting increased attention throughout the Empire, and the Forestry Society as well as the Forestry Department of the Ministry of Agriculture and Domains are discussing means for regulating the consumption of timber and for propagation. There does not seem to be any great cause, however, for apprehension, as a recent official report states that forests in Russia now cover an area of 188,000,000 hectares (464,000,000 acres). Among European countries Sweden comes next with 44,000,000 acres of forests. In Russia the forests cover 36 per cent. of the whole area of the country. The Swedish forests occupy 44 per cent. of the total area, and the Austro-Hungarian 32 per cent. of the territory of the dual monarchy. Reckoned by the population, there are 4·9 acres of forest to each inhabitant of Russia, 9·5 acres in Sweden, 10·4 acres in Norway, and 69 acre per head in Germany. The forests have a greater importance for Russians than for people of Western European countries, as villages and country houses are largely built of wood, stone and brick houses being almost unknown, and the forests furnish the main sources of fuel supply.—*Journal of the Society of Arts.*

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The Insect World in an Indian Forest and how to study it.

INTRODUCTION.

IN a note published as an Appendix to Volume XXVII of the *Indian Forester* (1901) I described, under the title of "A Note on the collection and preservation of entomological specimens, with a description of the methods to be employed in the study of life-histories of insects," some simple apparatus necessary to the would-be student of the Insect World—whether his aim be that of the collector only or that of the investigator—whose desire is to make himself acquainted with the life-histories and habits of this exceedingly interesting class of the Animal Kingdom. I alluded shortly to the lines on which this latter work should be taken up.

In the following papers I propose endeavouring to give, in somewhat fuller detail, some notes upon the great Orders and Families of Insects, which I trust will be of service to the would-be student of the insect life of our Indian Forests. Each of the Orders will be taken in turn, its characteristics considered, and the families containing species of insects of economic importance in Forests, dealt with as fully as is at present possible. Insects which are known to be or are considered likely to prove injurious will be alluded to at some length.

The real object is, however, whilst giving hints as to how the various Orders may be best studied, rather to draw attention to and lay stress upon the various Families which my own experience has shown—I should perhaps say is showing—are likely to be of paramount importance in this country, although so little at present being known about them, it has been usual in European text-books to either make no reference to them, or merely a passing allusion to the fact that they are relative to other better-known families of small importance. Whilst this procedure is, of course, quite correct where the European student, who spends his life in

Europe, is concerned, the case is rather different when the man so taught comes out to India and endeavours to apply his knowledge to the conditions around him in the Indian forest. He will soon find that the relative importance of many of the families he has studied must be rearranged, those he has only touched upon or merely heard of must be given a prominent place in his rearrangement, and old well-known friends relegated to the background as of comparatively small significance. I will not say that much can be done on these lines at present, but I trust to be able to aid the student to some extent in this direction.

The Insect World in the forest, as elsewhere, may be divided into two great groups, in the first of which come the Insects actually injurious to plant growth and which are in consequence inimical to man, in the second the predaceous and parasitic Insects, which from their habits of preying upon their fellows may be considered as the friends of the human race. It should be noted that these latter are in their turn devoured by other insects; whilst fungi undoubtedly aid largely in keeping within bounds the enormous increase which would otherwise, and at times does, take place owing to the great fertility and prolificness of Insect Life.

In fact, study and observation show that in all probability no insect exists upon the face of the earth which has not enemies of one kind or another to contend with, and which aid in keeping down its numbers. That this is as it should be becomes evident when it is remembered that Huxley calculated that the produce of a single Aphis (the green blight formed on roses, &c., are Aphids) would, in the course of ten generations, supposing all the individuals to survive, "contain more ponderable substance than 500 millions of stout men, that is, more than the whole population of China." The increase of this one family of insects is such that, were they not kept under, it has been calculated that in the course of two or three years they would, deriving their nutriment directly as they do from the plant in the growing state, leave no plant nutriment available for other animals save that which might be derived from plants they did not attack. In other words, Man would be very soon cleared off the face of the earth had not nature provided checks against undue increase of its insect population. At times the preyed-upon obtain for a season the upper hand, and the alarming rate at which they then spread is known to all.

In conclusion, I may say that in these papers I shall only make use of such technical terms as are absolutely essential, whose explanation is to be found in any elementary text-book on Entomology. I should like to point out, however, that personally I consider it inadvisable, when writing for and in the magazine of a great Scientific Department, to continually endeavour to eliminate all technical terms from articles in branches of science

which have a very considerable and important bearing upon the efficient carrying out of its work. A Forest Officer is essentially a highly trained scientific man, and can be written to as such. I consider it neither advisable nor necessary to write "down" to the unlettered tail of a Department so manned. The men who evince no interest in the subjects connected with their profession outside the mere daily routine, and those who, with neither merit nor education sufficient, have managed to drop into the service, can alike be left alone in their ignorance.

In these days when the study of science, having ousted the fetish worship of the dead languages from the place which it so long occupied in English colleges and schools, to the detriment of the Empire at large, is spreading and making itself the moving factor in the progress of the world, the specialist to be writing on a Botanical, Geological, Chemical, or Entomological subject, may pen his articles on the assumption that his readers have had the elements of a sound scientific education, and that they will be able to follow him if they care to do so.

PART I.

THE POSITION OF THE CLASS INSECTA IN THE ANIMAL KINGDOM.

It will be at first necessary to consider the position of the Insecta in the Animal Kingdom, and with this object in view the briefest of summaries of the Kingdom becomes essential.

Animals are primarily divided into the two great groups of the *Protozoa* or animals consisting of a single cell only (as, for instance, the *Amœba*) and *Metazoa* or multicellular animals.

The latter are again sub-divided into the *Cœlentera*, or animals without a body cavity (such as the sponge, coral, jelly-fish) and *Cœlomata*, or animals provided with a body cavity.

The *Cœlomata* comprise the rest of the Animal Kingdom and are divided into seven great Phyla, consisting of the *Platyhelminthes* or Flat Worms; *Nemathelminthes* or round Worms; *Annelida* or Earth Worms, Sea Worms, and Leeches; *Arthropoda* or Prawns, Crabs, Spiders, Scorpions, Insects, Centipedes, Millipedes; *Echinoderma* comprising the Star Fish and Sea Urchins; *Mollusca* or Snails, Slugs, and Mussels; and lastly the *Vertebrata* or *Chordata*, comprising the Fish, Frog, Lizard, Birds and Mammals.

We thus see that the Insecta form one of the divisions of the great branch *Arthropoda* or segmented animals. They may be said to be segmented animals, having three pairs of legs and breathing by *tracheæ*, a system of air tubes ramifying through the body and opening on the sides of the insect by means of a row of breathing holes or *stigmata*; the genital openings of insects are near the posterior end of the body.

For our purpose it will be sufficient to consider the Insecta as divided into the seven great Orders—*Orthoptera* (cockroaches, mantis, locust, grasshopper, cricket, &c.); *Neuroptera* (white-ants, lace-winged flies, ant lions, &c.); *Hymenoptera* (ichneumonids, ants, bees, wasps, &c.); *Coleoptera* (beetles); *Lepidoptera* (butterflies and moths); *Diptera* (two-winged flies); and *Hemiptera* (tree bugs, cicadas, plant lice, and scale insects).

These Orders will be considered in detail in Parts II to VII, into which these papers will, for convenience, be divided. Part VIII will consist of a short summary on the subject.

(To be continued.)

Development of the Sal Forests in Dehra Dun

THE area under reference is the plains portion of the Dehra Dun district, bounded on the N.-E. by the Himalayas, on the S.-W. by the Siwaliks, on the N.-W. by the Jumna river, and on the S.-E. by the Ganges river, forming roughly a parallelogram about 45 miles long by about 15 miles broad.

The chief features of interest in the physiography are the numerous river-beds (locally known as "raus") which cut up the country. These are dry for the greater part of the year, leaving exposed shingle beds, often of great width. They rise in the hills, forming torrents in the rainy season, bringing down a great quantity of *débris*.

The strata through which they flow consists of sandstone, gravel and conglomerates, with occasional thin bands of clay of a loose and easily denuded nature. The area is thus subjected to great erosive action by these rivers, resulting in continual change in the topography. By lateral erosion the rivers are constantly oscillating from side to side, denuding large areas and converting fertile land into shingle beds, with the formation of flood plains, which may become river terraces, as the beds of the streams are lowered by vertical erosion. From time to time these rivers change their courses, converting fertile forest land into a shingle bed. We may assume, without going very far wrong, that the whole of the area under reference has been subjected to this denuding action of rivers, and has been at one time or another in the condition of a shingle bed. In fact the nature of the strata indicates that they have been formed by sub-aërial denudation of the Himalayas, that is to say, they consist of *débris* brought down and deposited by river action.

The climate of the area under reference is practically the same throughout; but we do not find the area occupied throughout by one uniform type of forest characteristic of such climate. There are forests of quite distinct species, e.g., pure shisham forests, mixed forests, sal forests, &c.

These differences in the vegetation are due to local differences in the soil, caused by the erosive action of the rivers; or, in other words, to changes in the topography. The main distribution of plants is due to climate, especially rainfall and temperature, but the local differences in the vegetation are due to local factors, especially soil with its water-content, aspect, gradient, &c., or in other words, the physiography.

Where erosive rivers are actively at work, as in the Dun, the physiography is continually changing, and these changes are followed by changes in the vegetation. If there were no forces at work in changing the physiography, the struggle for existence would ultimately lead to the formation of a more or less uniform type of forest throughout a region with the same climate. Within a certain region having the same climate throughout, there is a steady development of the vegetation towards one type, characteristic of that particular climate. Thus in the Dun the highest stage in the development of the vegetation is the sal (*Shorea robusta*) forest, and all other forests are gradually developing towards this final stage. That they have not attained this stage long ago is due to the constant changing of the physiography, caused by the denuding action of the rivers.

As already stated, it may be presumed that the whole of the Dun has been at one time or other in the condition of a shingle bed, but a large proportion of the area is now covered with sal forest. The sal is a tree of an exacting nature, requiring good fertile moist soil, with good drainage, and is a species severely damaged by frost when young, so much so that it cannot come up in open places except under the protection of other trees. The sal forests cannot, therefore, have come directly into existence on open exposed alluvial shingle soils. Although it is not possible to actually observe the successive stages in the development of the sal forests on the same area, as the changes are gradual and may occupy a long period, yet an examination of the existing types of forests and of what is now taking place leaves little doubt as to the stages through which the sal forest is ultimately developed.

The general types of forest are :—

- (1) Pure shisham (*Dalbergia Sissoo*), or khair (*Acacia Catechu*).
- (2) Mixed forests* with isolated shisham or khair.
- (3) Mixed forests* with no shisham or khair.
- (4) Mixed forests* with isolated *Terminalias* and sal.

* These mixed forests contain such species as *Bombax malabaricum*, *Aegle Marmelos*, *Odina*, *Wodier*, *Phyllanthus Emblica*, *Moringa pterygosperma*, *Kydia calycina*, *Grewia vestita*, *Albizia Lebbek*, *Casaria tomentosa*, *Milletia auriculata*, *Stephyggyne parvifolia*, *Ehretia laevis*, *Careya arborea*, *Adina cordifolia*, *Arogeissus latifolia*, *Stereospermum suaveolens*, *Carissa spinarum*, *Hollarrhena anti-dysenterica*, *Zizyphus*, *Adhatoda Fatica*, *Milusa velutina*, *Semecarpus Anacardium*, *Mallotus philippinensis*, *Eugenia operculata*, *Schleichera trijuga*, *Bauhinia malabarica*, *Lagerstræmia parviflora*, &c.

(5) Sal forests predominating, with *Terminalias* and mixed species.*

(6) Pure sal forest.

These different types of forests represent the successive stages through which the sal forest is ultimately developed.

Pure shisham forests are found along the river-beds on new alluvium. They originate from seed deposited by floods on land afterwards left above the erosive action of the river, which we may call "flood plains," and it is only under these peculiar conditions that natural shisham forests are formed, and as these conditions do not again appear, the original shisham forest is unable to reproduce itself on the same area from seed, but is succeeded by a mixed forest, which affords a very good example of a change in vegetation due to a change in physiography. Shisham being a light-demander thins out early, and other species, such as *Bombax*, *Aegle Marmelos*, *Odina*, *Kydia*, *Grewias*, *Albizzia Lebbeck*, *Mallotus*, *Casuarina tomentosa*, *Ehretia*, *Stephygyne*, &c., gradually appear, and in time get the upperhand, forming a mixed forest with isolated shisham trees.

The presence of shisham is important, as indicating the comparative age of the topography. The pure shisham originates on a new topography left dry by the river. The presence of isolated shisham trees in the mixed forest indicates the alluvial origin of the soil and that the topography is still young; the absence of shisham indicates an older topography. As time goes on the soil improves under the mixed forest by the formation of humus, and *Terminalia tomentosa* appears and eventually sal. When once the soil has reached a condition suitable for sal, this species rapidly gets the upperhand, partly owing to its shade-bearing nature, and ousts other species, eventually remaining in possession of the ground. This steady development may not take place uninterruptedly. The river may start on a second cycle of erosion before the final stage is reached, and thus we may find a mixed forest in a state of retrogression towards the initial stage, instead of developing towards the final sal forest stage.

It is only under certain favourable conditions that the shisham forest is formed, so that this species does not always commence the development towards the sal forests. Flood plains may be formed without the development of a shisham forest on them. In this case the first two stages mentioned above would not occur. The land instead becomes covered with such species as *Orthanthera viminea*, *Calotropis procera*, *Saccharum* and other grasses. As soil improves shrubs appear and finally trees, forming a mixed forest as in the case already mentioned, to be followed by *Terminalias* and

*The last species to disappear and those found associated with sal are chiefly *Kydia calycina*, *Grewias*, *Phyllanthus Emblica*, *Lagerstræmia parviflora*, *Semecarpus Anacardium*, *Careya arborea*, *Adina cordifolia*, *Mallotus philippinensis*, *Eugenia operculata*, *Stereospermum suaveolens*, *Bauhinia malabarica*.

finally sal. The sal forest is thus gradually developed through successive stages. Certain mixed forests of a young topography present an abnormality in containing old *Adina* or sal trees, which must have been in existence before the present topography was formed. These are old trees which have resisted the denuding floods, and have been left standing on the new topography after the river has receded.

The erosive action of rivers is greatly increased by interference by man, by incendiarism, excessive grazing or felling.

A similar method of gradual development through successive stages may probably be traced for the forests in all regions subjected to denuding agency, and the Forest Officer, by understanding the conditions under which particular forests are formed and the physiographic changes taking place, will be in a better position to make suggestions for the future management of forests under his charge. The failure of natural reproduction may often be explained by a change in the topography since the original forest of that species was formed, as in the case of natural shisham forests. The presence of a particular species in the ground does not necessarily imply that the same area is in a condition to maintain another crop of the same species: the topography may have changed since the original forest was formed. Land once moist may be left high and dry by the vertical erosion of a river bed, which change in topography will be followed by a change in vegetation. It is therefore important to ascertain what physiographic changes are taking place and what will be the resulting changes in the vegetation.

24th June 1902.

B. O. COVENTRY.

Forests of the Jubbal State.

IN June 1901, I had an opportunity of touring through a portion of the forests of the Jubbal State in the Simla Hills. Being one of several small states comprised in the District, and being, moreover, situated in the Himalayas away from all tour-routes and thoroughfares, it is scarcely known beyond the limits of the District. I have tried to shew in the following pages that it nevertheless deserves notice, especially from Foresters.

The Jubbal State is about 250 square miles in area, comprising mainly two valleys which are drained by the rivers Shallu and Minis, both tributaries of the Tons river—itself the most important of all the tributaries of the Jumna. Of the total area, about 100 square miles are under the Forest Department, of which about 12 are blanks or under cultivation, the rest being wooded.

A large, crooked ridge, known as the Kakradhár, which, starting from the Chur Peak, at first stretches towards the east, and

then after a short turn towards the north runs more or less straight east again as far as the Tons on which it abuts opposite Sangota, marks the water-parting of the two main valleys and forms, as it were, the backbone of the Jubbal country. There are several peaks in it of which Chogal, Kau, Gutu and Ishar are notable, varying in height from 7,000 to 11,000 feet. Two outlying areas in the Shallu valley belong to Sirmoor, the premier of the Hill States of Simla. As a set-off, Jubbal possesses the whole of the wooded part of the Patal valley, west of the great Manilhadhar which, starting from the Chur, separates the Shallu valley from the Giri valley. The capital of the State is, however, outside the tract of country comprised in these three valleys. It is in a small portion of the State lying in the valley of the Bishga which drains into the Pábar, the largest tributary of the Tons, this portion being connected with the main territory by a narrow neck between the Pandur and Taroch states. The Minis, Shallu and Pátal valleys, like several others, radiate from the Chur in various directions, not so the Bishga valley, which is cut off by a gigantic ridge, marking the western and northern limits of the Shallu basin. It is indicated by several high peaks, the most notable being Chogat, Baigat, Kuper and Chachpur. Patarnála is situated on this ridge.

The prevailing geological formation is slate. On ridges and exposed spurs it has generally weathered into shale, but towards the Chur is a band of mica-schist where, therefore, the soil is very micaceous. On and around the Chur huge blocks of granite, often gneissose or schistose, abound. In some places the granite contains large elongated crystals of tourmaline. In the slate bands of limestone occur in places. The slate is for building purposes of a much superior quality to that which forms the Chakrata series of Jaunsar and, perhaps, might be quarried for export down-country.

The rainfall of Jubbal is probably similar to that of Jaunsar, where it is from 60 to 75 inches in the year. That in the Shallu valley, however, is perhaps somewhat lighter than elsewhere, the rain-clouds being obstructed by high ridges on all sides, and the valley presenting to them a long narrow gorge at its exit on the Tons.

The Shallu valley, however, is the most picturesque part of Jubbal. It is fairly well populated and in consequence not very much wooded, although just enough of woodlands have been left in patches, especially in ravines, to break the monotony of the long stretches of terraced fields of the villages. The villages themselves, with their apricot-orchards and neatly-built chalet-like houses perched on picturesque hill tops or gentle slopes, look extremely attractive. The Minis valley, especially the upper part of it, presents a striking contrast to this tame, though beautiful, scenery. There the forests are in large masses, sombre and

dark-green towards the Chur where silver fir in both its forms predominates, scarcely relieved here and there by the still darker foliage of the Kharshu, but of a lighter colour further down where they look somewhat familiar to persons who have seen the better class of forests of Jaunsar and Tehri-Garhwál. This is the region which is most worth a visit by Foresters and also by lovers of grand forest scenery. To the former the visit will be as instructive as interesting.

The Chur, about 12,000 feet, being the highest peak for miles away and being well wooded almost up to the summit, commands a panorama of exceptional grandeur. It is about 35 miles from Simla and a good bridle road runs from it through Fāgu nearly up to the summit. The Jubbal Forest Department has made good inspection roads traversing the forests of the Chiuua Block and all the forests of the Bhālu and Banāh valleys. But I would warn European travellers against leaving Fāgu without providing themselves with supplies sufficient for the number of days they propose to be out, and also against coming unprovided with tents. When the Saia-Tiuni road is completed, the Minis valley will become accessible to travellers from Dehra and Chakrata. At present the only route for them is through Tiuni, Piuutra and Deya, which is very circuitous. This was the route taken by me.

FORESTS IN THE SHALLU VALLEY.

As mentioned before, the Shallu valley is poor in forests. There is an excellent bit of Deodar forest on either side of the Shantagādh near Murāch, called the Chhānóg forest. It is in a well-sheltered corner, rather far from the larger villages and no facility at present exists for extraction, circumstances which go far to account for its existence. But for this, the whole of the northern half of the Shallu valley (having generally a southern or western exposure) is almost treeless. The Mus-soorie-Simla road runs through these bare and dreary hills nearly the whole way from Tikri to Piuutra.

Along the right bank of the Shallu there are patches of Chir forests aggregating about 2,000 acres in area, but they are not much cared for at the present moment, many of them not being even fire-protected. About 12 years ago some 300 trees were sold standing at Rs.3 per tree, but since then no purchaser has been forthcoming and the present Working Plan has, I was told, left the Chir forests entirely out of account. The trees are of fair size and are in places quite as good as are seen below Kathian in Jaunsar.

Above these comes a belt of typical Deodar forest, extending from above Piuutra all the way to Sarain and Khagna, the characteristic feature of which is that it has been worked over by traders or contractors under leases on absurdly easy

terms, and has in consequence been very much overworked in places. Some of these men built houses which now share the ruin their tenants spread among the once rich and beautiful forests that surrounded them. The mature trees that are now found in these parts are generally worthless as timber, being hollow, partially rotten, or too much branched, but until they tumble down they are of value as seed bearers. The regeneration has happily been very good on the whole, especially where grazing is not too heavy. Kail is everywhere associated with Deodar, especially in the thickets, and needs cutting in many places to set free the Deodar. The earliest history of forest operations was enacted in these forests. There are blocks of forests, especially in the valley of the Hamalti, a large tributary of the Shalla, *e. g.*, Chiuma, Saráin, Khagna, etc., where utilizable Deodar trees are now being removed under the provisions of a Working Plan which, however, has not yet been published.

Above this belt, on the Minis-Shalla water-parting occupying the higher elevations, is a more or less continuous strip of fir forest which has never been much worked, but is open to grazing for Gujar's cattle.

FORESTS IN THE MINIS VALLEY.

In the Minis valley the forests can be classed under the following three categories:—

(i) Those that were cut over by unlicensed sleeper-cutters in days before the constitution of the State Forest Department.

(ii) Those that were worked under the former members of the Forest Department in days when the requirements of Deodar were very imperfectly understood.

(iii) Those that are being worked now under a Working Plan or at any rate under the supervision of the District Forest Officer of Simla.

To begin with the first. Of several such forests I could see only part of one, the Topla Forest. It is situated in the Bhálu valley on the north slope of the Topladhár.

The old practice all over Jubbal was for timber-cutters to obtain a general permission from the Durbar to exploit a certain forest and then to cut as much as they wanted to or could. Nobody foresaw the evil of this and the State possessed no agency by which it could control their action even if it had the desire to do so. All that it did was to post a few ill-paid Darogas at convenient floating depôts, whose ostensible business was to check the timber passing by their depôts and to remit to the State treasury the royalty levied on them. It was nobody's business to see how the Daroga discharged his very responsible duty, or how he managed to live like a lord on a pay of Rs.5 to Rs.10 a month. Less, far less indeed, was it anybody's business to see how the forests fared under such conditions.

The timber-cutter had only to choose a convenient bit of forest and to apply for permission to cut timber. Topla being one of the best forests, both in point of its stocking and its convenient situation, was a great favourite with them. But in 1889, rumours were afloat that restrictions were going to be imposed which would compel them to take licenses and to pay a higher rate of royalty. On hearing this it is said that they cut down 1,400 trees in 24 hours.

The Topla Forest seems to have been at one time a more or less even-aged mature crop, for at the present moment only scattered mature trees are seen over a dense crop of young reproduction which must have come up after, and probably in consequence of, the heavy fellings which, without the knowledge of the perpetrators, were perhaps in the nature of an open seed-felling. This indeed seems to be a conspicuous feature of nearly the whole of the Jubbal Forests. Wherever fellings have been heavy within certain limits, regeneration has come up very well.

In the second type, too, the fellings have in some places been very heavy, *e.g.*, near the village of Juálnu on the right flank of the Juálnu khud, which was cut over in 1892. But the chief feature of this type of forests is the excessive zeal with which girdling work was done by the State Forest officials. These were trained men, but unfortunately the Jaunsar Division had erred in the same direction and no one had yet raised his voice against the blunder, so it was no wonder that the Jubbal men thought they could do no better than copy what they had seen in their "training ground." Copy therefore they did, but unluckily for the forests, on a very much larger scale. Up to about 8,000 feet the mistake has not been quite so fatal; for being in its proper home Deodar has been able to hold its own and does not seem to miss the enormous Kail and other trees killed out from its midst. Not so in higher elevations. Here the girdling has done absolutely no good to the Deodar, but has afforded a most excellent chance to the usual weeds, such as Rosa, Rubus, Ribes, Viburnum, &c., to monopolize the soil, in many places smothering the very seedlings the girdlers sought to favour. Stately spruce, silver fir and oak trees have been girdled, hundreds in places, over a few miserable leaderless Deodar seedlings which possibly had been under suppression for scores of years. The dead giants now stand, ugly and grey, like masts of ships, a menace to wayfarers and workers in the forest on a windy day. Kanda, Saráo and Munálog forests shew examples of this kind of girdling, the last-named being, perhaps, the worst.

We now come to the third type of forests in the Minis valley. These are by no means virgin forests; still when the Working Plan was being framed, they were found to contain a sufficient number of exploitable trees to justify fellings within a possibility fixed by the Working Plan. These are Charan, Kanah, Málhat, Serti

Reoshti, Mahsmund, Juálnu, &c., all on the northern flank of the Minis valley. At the time of my visit only Juálnu and Máhat were being worked. It should be noted that the Working Plan has included under similar operation a few blocks of forests in the Shallu valley, *e.g.*, Chiuna, Saráin and Khagna, all at one time worked over heavily by sleeper-cutters.

WORKING OF THE PRESENT FOREST DEPARTMENT.

The system of working is very similar to that in vogue in Jaunsar, with this important difference that here each tree marked for felling is consecutively numbered and entered in a register which gives the girth, and in a few words its condition, especially such as justify its selection for felling. This obviously has many advantages.

The Forest Department of the State has entered into a contract with the Oudh and Rohilkhand Railway to supply 45,000 B. G. sleepers annually for 4 years, delivered at Jagadhri. To allow for loss in transit about 50,000 are cut in the forest. Shorter pieces are converted into M. G. sleepers and thinner pieces into karries. These find ready purchasers at Dakhpathar and Abdullapur. The sleepers are not sawn on all four sides. They are generally simply trimmed or axe-hewn on one or two sides and sawn along the others. In the year 1900-1901 altogether 66,787 pieces were converted. For all this, 2,297 green trees and 98 dead trees were cut, besides 28 removed in thinnings. About 3,000 pieces of timber were lost in transit. So far as I could judge, the trees had been well selected in the coupes that were being worked and the wastage in sawing was remarkably little. The sleepers also are very well made, judging from the fact that 95 per cent. are generally accepted as first class by the Railway authorities.

A depôt has been established at Rihár on the Juálnu khud which is fit for floating in the rainy season below that place. All timber is carried on coolies' backs down to the depôt and this constitutes the heaviest of all working items. Below this point, down to the Chari depôt on the Minis, a distance of about 6 miles, telescopic sliding is resorted to in the rainy season. Below Chari the timber is allowed to float unaided. For a distance of about 7 miles, the Minis runs between Jubbal and Sirmoor. The latter State, therefore, charges royalty on timber floated in it by the former. From the mouth of the Minis to Dakhpathar the transit is controlled by the Jaunsar Forest Division. The rest of the career of Jubbal timber is similar to that of all other timber passing through Dakhpathar, with only this difference that very little of it, if any, is taken beyond Abdullapur (Jaghadri) where the N.-W. Railway crosses the West Jumna Canal.

The expenditure on sowing and planting in 1900-1901 is said to have been only Rs.173. This seems very inadequate considering

the extent of blanks, over 7,000 acres, existing inside the forests, especially in Bhálu, Juánu, Kanah and Reoshti. In some forests, e.g., Kanah, Malhat, etc., natural seedlings are found in dense masses side by side with vacant spaces. The latter can easily be filled up at a very small outlay with superfluous plants taken with a ball of earth during the rains from the former.

It is a curious fact that the Forest Department has to depend almost entirely upon foreign labour for all its work. The sawyers come from Chamba and Kulu, the carrying, road making, etc., are done by Garhwális, the floating is done by men from Kangra to which country belongs also the Bania who supplies provisions to the coolies. The children of the soil seem to be indolent in habit, and though they live in much neater houses in by far cleaner surroundings than their neighbours across the Tons, they are far less enterprising and care very much less for cash. They engage themselves only in cultivation which, however, they seem to carry on in a more improved style than the Jaunsaris.

The purveying arrangement presents a novelty worth noting. Instead of subsidising a Bania for supplies, the State gets from 8 to 13 per cent. on sales to workmen for its grant of monopoly. The workmen do not pay cash for what they take from the Bania, but hand him an order from the contractor in charge of the work or an authorized official. This forms the basis of account with the Bania on the one side and with the coolies on the other. In spite of this subsidy it is significant that the selling rates and working rates are very much the same as those prevailing on similar works in neighbouring districts. The Bania at present has his shop at Bhálu and brings his supplies on mules all the way from Simla, over a distance of about 50 miles.

The State Forest Department is much vexed over the grazing question. It does not allow foreign cattle—those brought by Gujars—to graze in any forest where Deodar grows, relegating them to the at present valueless high level fir and oak forests. But the village cattle are allowed to graze everywhere without restriction. The Department is crying out for a proper settlement of villagers' rights, especially in this respect, but the Durbar has not as yet seen its way to accede to this wise demand. The result is that near villages, within a radius varying from one quarter to one mile according to their magnitude, regeneration is generally nil. Fortunately, however, villages are comparatively few in the vicinity of the better classes of forests—the bulk of the population being congregated on the right flank of the Shallu valley, where, as already stated and perhaps owing to that very fact, valuable forests are few and far between.

The forest areas have all been well demarcated by means of substantial boundary pillars and lines, leaving nothing more to be desired in this respect. The Imperial Forest survey has taken

in hand the survey of the State forests. When this is completed, accurate maps will be available.

Protection from fire presents no great difficulty so far as physical conditions are concerned. But here again the Department is much hampered by the apathy of the Durbar which is loath to take any notice of delinquency in this respect on the part of the ryots, much more so to punish them for it.

The flora of Jubbal is very similar to that of Jaunsar, especially as regards composition, but the combination and the zone of occurrence with regard to some trees are somewhat different. There are many places, *e.g.*, the Kau peak, the forests above Bhálu and Kanda, etc., where the Kharshu oak (*Quercus semecarpifolia*, Sm.) is found mixed with Aiyár (*Pieris ovalifolia*, D. Don) and Deodar. Such a combination is not seen in Jaunsar. Again, in Jaunsar *Pinus excelsa*, Wall., and *Picea Morinda*, Link., are never seen below 6,500 feet, but in the Pátál valley they go as far down as 4,000 feet, the former even lower down, associated with such species as *Cedrela Toona*, Roxb., *Melia Azedarach*, Linn., and *Grewia oppositifolia*, Roxb., side by side near villages with the plantain and castor-oil plants. They occur so low generally in open village forests, where they are heavily lopped for litter and consequently look far from happy, never getting beyond the pole stage,—yet there they are.

DEHRA DUN, the 30th June 1902.

UPENDRANATH KANJILAL.

II.—CORRESPONDENCE.

III-OFFICIAL PAPERS AND INTELLIGENCE.

**Quarterly Report of the Director of the Scientific and
Technical Department of the Imperial Institute.**

IMPERIAL INSTITUTE ROAD,

LONDON, S. W.,

17th January 1902.

I have the honour to forward herewith, for submission to your Committee, the Quarterly Report of the Director of the Scientific and Technical Department.

In the commencement of that Report, Professor Dunstan refers to the possible issue, during the present year, of a volume of technical reports and scientific papers which have been issued by the Institute from his department. This subject has still to receive the consideration of the Executive Council at a convenient opportunity ; and, should such publication be agreed to, the volume would probably also include certain purely technical reports of special interest, furnished to the Institute from other sources.

The action of the Foreign Office and of the Colonial Office, to which Professor Dunstan directs attention in the fourth paragraph of his Report, was taken upon the recommendation of the Advisory Committee appointed by the Executive Council of the Institute, in connection with the Scientific and Technical Department. This Committee, which includes representatives of the Foreign Office, the Colonial Office, the India Office and the Board of Trade, approved of the extensive circulation of a Memorandum which I prepared on the scope of operations of the Scientific Department ; and this circulation has already been attended with useful results as pointed out by Professor Dunstan.

I have, etc.,

F. A. ABEL,

Honorary Secretary and Director.

To

*Major-General Sir OWEN TUDOR BURNE, G.C.S.I.,
Chairman of the Indian Committee.*

IMPERIAL INSTITUTE.

Quarterly Report on enquiries conducted for the Government of India by Professor WYNDHAM R. DUNSTAN, M.A., F.R.S., Sec. C.S., Director of the Scientific and Technical Department of the Imperial Institute.

In making my Quarterly Report to the Indian Sub-Committee on the investigations conducted for India in the Scientific and Technical Department of the Imperial Institute, I take the opportunity of expressing the pleasure with which I received the announcement that the Government of India had sanctioned an increase in the annual grant made to this department. This action will enable better provision to be made for the conduct of the several important Indian investigations which are at present engaging the attention of the department.

It is also satisfactory to learn that the Department of Revenue and Agriculture will be prepared to determine those investigations which it may consider useful or necessary to be proceeded with in turn as the current work of the department will permit.

With reference to a number of enquiries which have been received, some through the India Office, for copies of the reports made by this department on Indian and Colonial Economic products, which at present can only be answered, as far as India is concerned, by furnishing copies of the Annual Reports of the Indian Sub-Committee, it is not improbable that during the present year a first volume of technical reports and scientific papers from this department may be issued by the Imperial Institute. As some of the reports on Indian products have been published in the *Agricultural Ledger*, it would be a convenience if I were supplied with a number of copies of each of these for distribution to applicants.

In the autumn of last year despatches were sent from the Foreign Office and from the Colonial Office, covering a Memorandum on the scope of the operations of this department, suggesting that it might be utilised by our Consuls in foreign countries, and by our representatives in the Crown Colonies and Dependencies, for the purpose of obtaining technical and scientific information as to economic products. In the course of his despatch, Mr. Chamberlain drew the attention of the Colonial Governments to the action of India in appointing a special officer, the Reporter on Economic Products, to be the means of communicating to this department information as to the subjects and materials which require investigation, chiefly in the interests of commerce and manufactures. It is understood that the India Office has caused this Memorandum to be forwarded to the local Governments in India, so that India may be fully informed of the facilities offered by this department.

The result of the issue of these despatches from the Foreign Office and the Colonial Office has been to bring a very large number of enquiries as to mineral and other economic products which our representatives abroad consider might be utilised in the interests of British trade.

I append notices of the reports of enquiries which, since the date of my last Quarterly Report, have been communicated to India, and also of the principal Indian investigations which are now being conducted in the Laboratories.

TANNING MATERIALS.

Reference has been made in a previous report to the investigation commenced at the instance of Mr. Ribbentrop, late Inspector-General of Indian Forests, of the barks of *Shorea robusta* and *Terminalia tomentosa*, with the view of preparing from them a satisfactory tanning extract, such as would commend itself to European tanners. The preliminary results of this enquiry were satisfactory, but it has been temporarily stopped owing to want of material. Advice, however, has now been received of the despatch of a large quantity of both these barks by the Inspector-General of Forests, and as soon as they arrive, the investigation will be completed as rapidly as possible.

With reference to the full report made by me in July last on the tanning value of *Cæsalpinia digyna*, I am hoping to receive shortly from the Reporter on Economic Products information as to whether it is likely that a supply of this material could be depended upon from India at the price named. I also expect to receive a reply from him as to the cultivation of *Cæsalpinia brevifolia*, to which I drew attention at the close of the Report referred to.

POISONOUS FOOD-GRAINS.

A further examination of the seeds of *Lathyrus sativus* is being conducted with fresh material received through Mr. J. B. Fuller, having been collected in the village of Riano in the Damoh district, where poisoning by *Lathyrus* is prevalent. As soon as the chemical constituents have been ascertained, I intend to make arrangements with a physiologist to ascertain their exact physiological action.

My attention having been recently directed by Colonial botanists to the fact that several plants bearing food-grains are reputed to be poisonous under certain conditions, I have communicated with Dr. Watt, asking his assistance to procure samples of young Millet or Sorghum, and of the seeds of *Phaseolus lunatus*, so that their supposed toxic properties may be investigated. These enquiries are likely to be of considerable interest and importance in connection with a general examination of poisonous food-grains and fodder-plants which has been recently undertaken in this department at the request of several of the Colonial authorities.

A paper giving an account of the investigation of the nature and origin of the poison of the Egyptian fodder-plant, *Lotus arabicus*, has been published in the *Philosophical Transactions* of the Royal Society. A copy has been forwarded to India for Dr. Watt's information.

MEDICAL PLANTS.

In accordance with a request from the Reporter on Economic Products, a chemical examination of the seeds of *Strychnos Rheedii* has been made, and the results were reported in October last. Only a small quantity of material was available for this investigation, and its examination renders it probable that this seed contains no strychnine, but only brucine—a conclusion which requires to be verified by the examination of more material and at the same time other Indian varieties of *Strychnos* by the Reporter on Economic Products.

The work of examining the constituents of the various Indian Aconites collected by Dr. Watt has made steady progress, and it is intended to prepare several reports on this subject during the present year. In this case the work of isolating and studying the poisonous constituent has been extended to the study of its physiological action, a research which has been undertaken by Professor J. T. Cash of the University of Aberdeen.

A consignment of the roots of *Aconites palmatum* was applied for last year, but has not yet been received. As soon as it arrives, a further investigation of these roots will be commenced.

FIBRES.

I reported in October last on some samples of Agave or Sisal fibre grown in India, some at Saharanpur, others in the Gwalior State and in South Sylhet. The results of the chemical examination of the fibres was satisfactory, and a good quotation was obtained from the fibre brokers in the event of certain of the samples being more carefully prepared. On this point I have made certain suggestions in the Report referred to.

In November last I sent to India a report on the properties of two varieties of Indian Jute which had been offered for sale on the London market, but were not represented among the fibres shown in the Indian Section of the Imperial Institute. In this report I have asked Dr. Watt for certain information with reference to the origin and preparation of these fibres which appear to command a fair price on the London market.

GRAPHITE.

At the request of Mr. F. R. Mallet, formerly Superintendent of the Geological Survey of India, an examination has been made of a sample of Graphite from the Kalahandi State, having been sent to him by Dr. T. Walker, formerly of the Geological Survey. The chemical analysis of the samples showed that it contained much mineral matter, and was not equal to Ceylon Graphite of average quality. A part of the sample, together with a statement

of its composition, was sent to one of the largest users of Graphite in this country and a report obtained on its technical and commercial value. The conclusions arrived at by this firm were not satisfactory and the material was reported to be of small value.

GUMS.

A number of Indian gums, likely to be of service in the Arts, are being examined in this department, in continuation of two previous reports on this subject. One variety is receiving special consideration on account of the peculiarity it possesses of acquiring acid properties when it is kept.

INDIA-RUBBER.

No new samples of india rubber have been recently-received for examination, but the investigation of the coagulation of rubber latices is being proceeded with.

WYNDHAM R. DUNSTAN,

Director, Scientific and Technical Department.

14th January 1902.

V.-SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

By F. FINN, B.A., F.Y.S.

CHAPTER III.

MONAULS AND BLOOD-PHEASANTS.

(Continued from p. 308.)

The Monauls are very easily recognizable birds, being of large size and stout and heavy make, with comparatively large heads and bills, short shanks—shorter than the middle toe, and tails of only medium length, flat and nearly square like a pigeon's. There is a bare blue space round the eye in both sexes, but in plumage they differ absolutely, and the cocks only possess spurs, which are not very long. Four species are known, of which two are Indian.

THE COMMON MONAUL OR IMPEYAN PHEASANT.

Lophophorus refulgens, Blanford, Faun., Brit., Ind. Birds Vol IV., p. 96.

Native names :—*Lont* (male), *Hani* (female), *Nil-mor*, *Yung-timor*, Kashmir; *Nilgur*, Chamba; *Munál*, *Nil* (male), *Karari* (female), Kulu, *Munál*, *Ghar-Munál*, *Ratia Karwan*, *Rabnal*, *Ratkap*, N.-W. Himalayas; *Datiya*, Kumaun and Garhwal; *Dafia*, Nepalese; *Fo-dong*, Lepcha; *Chamdong*, Bhutias of Sikkim.

The male Monaul has a fine crest of feathers with shafts bare nearly to the tip, where there is a lance-head-shaped webbed portion; it is more or less erect. This crest and the head generally and a streak along each side of the breast are of an intensely brilliant burnished-green; the back of the neck is burnished copper-red, changing to golden-green in some lights. The upper part of the back is bronze-green, the lower silver-white. This latter colour is usually concealed by the wings, which are metallic purple with metallic blue tips to the feathers. The under surface of the body is velvety black and the tail cinnamon.

The hen has a short crest of ordinary feathers; she is of a mottled-brown, the light marking to run in streaks. Her throat is pure white, and her general appearance is much like that of a huge partridge.

The young birds resemble her, and the male does not attain its full plumage till the second year, and even then, curiously enough, the seventh-pinion-quill remains brown a year more.

The beak of the Monaul is horn-colour and the legs olive-green—what is called “willow” by poultry fanciers. The bright blue face noted above is most characteristic of these birds. The cock is about twenty-eight inches long with the wing nearly a foot and the tail nine and a half, the shank three inches in length and the bill two. The hen is a little over two feet long.

The common Monaul is found throughout the Himalayas, and even extends west to Afghanistan and Chitral. It varies its vertical range according to the time of year and the part of the hills inhabited, going higher in the Eastern Himalayas than the Western, and of course much higher in summer than in winter. It is not likely to be found, however, above 15,000 or below 4,500 feet at any time.

It is usually a forest bird, although in summer it may be found out on the grassy slopes above the level of trees. Only a few are seen in company, males being more solitary than females. The food is especially composed of grubs and roots, the Monaul being much addicted to digging, an operation it performs with its beak, for it does not scratch like most birds of this family. The comparatively large bill, however, forms a most effectual hoe, and the bird is probably of great use in the forest in turning over the surface and destroying insect pests.

It is likewise most excellent eating and carries a great deal of meat, so that it is in every way a bird to be encouraged; and the snaring of these splendid birds for their skins ought to be put a stop to, as a very large number are destroyed in this way.

The Monaul breeds in May and June, the hen laying some times as many as six eggs, but generally fewer, in a nest under a

bush or tuft of grass. The eggs are buff, speckled with brown. The display of the cock is of the frontal type, the attitude being much like that of the turkey. His call is a loud plaintive whistle, unlike the harsh notes of most birds of this family.

It is worth knowing, considering how many people now reside in the hills for long periods, that the Monaul is capable of complete domestication; the birds may be brought up so tame that they can be allowed to go about at large like poultry. The species is also a very suitable one for acclimatization as a game bird wherever congenial localities exist, as it affords good sport, being wary and readily taking wing. The cock varies a good deal in colour, nearly black and white and pied varieties, and others with the copper on the neck replaced by steel blue having been recorded. The last-named has been described as a distinct species under the name of *Lophophorus mantoni*.

THE BRONZE-BACKED MONAUL.

Lophophorus impeyanus, Blanford, Faun. Brit., Ind., Birds, Vol. IV., p. 97.

The male of this species resembles the last in size and form, but differs in having the lower back bronze and purple instead of white, and the underparts glossed with green instead of being jet black. The hen is not known, and only a very few of the other sex have been obtained, all in Chamba, south-east of Kashmir.

It seems, from an account by Major G. S. Rodon, in the *Journal of the Bombay Natural History Society*, that the native *shikaries* of the locality say that this form is merely a "sport" from the common Monaul, which likewise occurs there. Considering the proneness of the common species to variation, and the unlikelihood of two species of pheasants, differing only in colour, remaining distinct in the same district, I am strongly inclined to think that their account is correct, and that the Bronze-backed Monaul, like the Black-winged Peacock, is not a true species, though excellently exemplifying a variation from which a species may arise. The subject is one which would well repay investigation, and I hope that any one who may be living in Chamba will look out for a cock Monaul showing no white upon the back, and thenceforward investigate his family and relationships, if possible. It is a pity to kill the bird, as the form is now known, and it would be more interesting scientifically to find out about its propagation, although, of course, breeding in confinement would be an easier and simpler means to this end.

There exists a very distinct species of Monaul in the Mishmi Hills, very near our Assam Frontier, and hence probably a future Indian bird. This is the crestless Monaul (*Lophophorus sclateri*), a species which differs markedly from the common Monaul in having no crest, but the crown of the cock covered with short curly or frizzled feathers. The wings are also shorter.

In general colour the two species are very similar, but the male of the crestless bird has the upper tail coverts and tip of the tail pure white as well as the rump. In the hen the rump is very light and the tail has a broad white tip to correspond.

As there is only one other species of Monaul known, and this lives in Western Szechuen and Eastern Koko-nor, and may ultimately find itself a British subject, it is as well to mention it. This is L'huys's Monaul (*Lophophorus lhuysii*), an even more splendid bird than the common species. It exceeds this in size, and has more of the fiery copper in the plumage, besides showing the lower back and tail nearly all shot-green and purple with a little white. The crest is well developed, but of ordinary shaped feathers.

The hen of this species is readily distinguishable from the common Monaul hen by having a large white patch on the back. Père David stated many years ago in the *Birds of China* that this species was in danger of extinction, and I sincerely hope that it will be protected or domesticated before it is too late. It is, except, perhaps, the ocellated Turkey of Honduras (*Meleagris ocellata*), the most richly coloured of all birds whose beauty depends on a metallic gloss, and it would be a great pity were it lost to the world.

THE BLOOD-PHEASANT.

Ithagene cruentus, Blanford, Faun., Brit. Ind., Birds, Vol. IV., p. 103.

Native names :—*Chilime*, Nepalese ; *Semo*, Bhutan, *See-mong*, Lepcha.

Only one species of this very well marked genus is found with us. It is a small bird for a pheasant, being about a foot and a half long, with a broad rounded tail not so long as the closed wing, the whole bird being thus rather partridge-like in style. The plumage is very characteristic, being long, full, and soft ; the crown has a short bushy crest, and there is bare skin round the eye. Cock and hen are much alike in shape, but differ absolutely in colour, and the former has several spurs on each leg.

In colour he is grey streaked with white above and on the flanks and lower belly ; the breast is apple-green splashed with crimson, and the throat and feathers under the tail are crimson.

The hen is brown finely pencilled with black, and with a grey cap and chestnut throat.

The legs are coral-red, as also are the base of the bill and the bare eye-patch, which is brighter in the male, however. The bill is black.

The cock will measure about eighteen inches, with a wing of eight and-a-half, tail nearly seven, shank nearly three, and bill under one inch. The hen is a little smaller. This is a thoroughly alpine bird, ranging between ten and fourteen thousand feet in the Himalayas, where alone it is found. It occurs in Nepal, Sikkim, and Bhutan, but its exact eastern and western limits are unknown, except that it does not extend to Kumaon. In Sikkim, at all events, it inhabits pine forests, feeding on the shoots of the conifer and on various other leaves, seeds, and fruits. The flavour consequently varies, and sometimes it is so strong and unpleasant that the bird is hardly fit to eat at all.

In such cases the objectionable taste could probably be in great measure removed by "drawing" the birds as soon as killed, as no doubt the food they contain taints the meat.

The young have been seen in May, but beyond this nothing is known of the breeding of the species. Birds of the year have no spurs, and in older specimens they vary in number, being different on each leg; four on one and five on the other seems to be the maximum. With such saw-like shanks the Blood-Pheasant cock ought to be able to give a good account of himself in a fight; but in the autumn, at all events, males and females are found associating together in flocks of more than a dozen. The Blood-Pheasant is not a shy bird, and much prefers running to flying; its call note is a squeal like a kite's, while it has a shorter cry of alarm. It is suspected of burrowing under the snow in winter like some grouse; indeed, the short-tailed hill pheasants of the East recall grouse in more ways than one, and evidently take the place of those birds in the economy of nature.

Only two other species of the present genus are known, and one of these, as it occurs near Indian limits, in Eastern Tibet and Western Szechuen, deserves mention here. This is Geoffroy's Blood-Pheasant, in which the male much resembles the Indian bird, but has the throat and breast grey, thus being duller in colour, while the hen is greyer above and has the tail indistinctly edged with crimson.

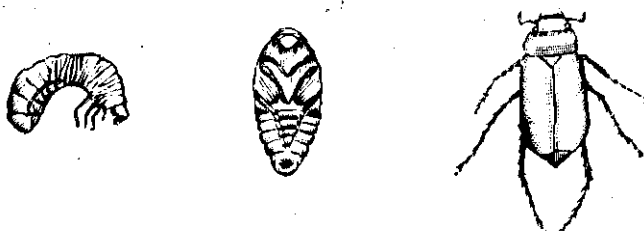
(To be continued.)

VI.—EXTRACTS, NOTES, AND QUERIES.

A beetle damaging *Cryptomeria* Plantation.

I enclose a note on a cockchafer-like scaraboid beetle found doing serious damage in a *Cryptomeria* plantation last month.

Specimens were sent to the Indian Museum for identification, and were reported to be indetical with, or closely allied to, *Holotrichia intermedia*, Brenske.



Larva, pupa and imago (natural size) of beetle, found killing *Cryptomeria* seedlings 2 or 3 feet high and 4 or 5 years old in plantations near Hoom (Darjeeling) at an elevation of 5,000 to 6,000 feet.

The damage is done by the larva, which gnaws all the bark off the main and lateral roots.

The perfect insect is of a dark chestnut colour.

Specimens of the insect in all stages were found on 12th May 1902. But the beetles seemed in most cases to have already bored out (from the ground) and flown away.

Only one beetle seems to attack each plant, but is quite able in most cases to kill it.

Darjeeling, 12th May 1902.

B. B. O.

The Chemistry of Forest Products.

The United States Department of Agriculture has recently established a laboratory for the study of forest products, the scope of the work of which is described in an article by W. H. King, of the United States Department of Agriculture, on Work in Dendro-Chemistry in the May number of *Forestry and Irrigation*, from which we take the following extract.

"The first work taken up by the laboratory was a study of the chemical composition of the wood and bark of the *Quercus prinus*, *Quercus alba*, *Quercus rubra*, and *Quercus velutina*, our object being the determination of the relationship existing between the chief constituents and the variations occurring in different sections of the trees. This investigation has been ex-

tended to the Western Hemlock, and other trees will be taken up in turn until we have an exhaustive series of analyses covering the most important American species. Naturally an investigation of this kind is mainly theoretical, but it must not be forgotten that it has also a practical value, especially with trees which are important sources of tanning materials.

In response to a general demand, we have formulated plans for a study of the availability of certain hitherto unused woods as a source of wood pulp. Spruce and poplar have so far been chiefly used for this purpose, but the supply of these woods is being rapidly exhausted, and other woods will in time have to be used. It is proposed to make this work most comprehensive, both from a chemical and microscopical standpoint. The various woods will be subjected to the processes of disintegration now used, the conditions obtaining in practice being imitated as closely as possible, when the resultant pulp will be studied with reference to the yield, nature, and condition of fibre and utilised as a basis for papers. The results thus obtained will then indicate the variations necessary in the processes so as to make them conform to the properties peculiar to each wood. In connection with this work we have planned a study of the composition and physical characteristics of the various papers containing either mechanical or chemical wood-pulp which are found in the American market, our ultimate object being the establishment of a paper-testing laboratory similar to that now operated by the German Government in Berlin. The necessity of such a laboratory is apparent when we consider that practically all official publications are now printed on such paper, and that the life of wood-pulp papers is in general very brief. The importance of certain standards is self-evident, and we hope to establish and enforce these for the American papers, at least in so far as they are furnished to the Government.

An investigation recently suggested, and which will receive our attention as soon as the material is at hand, is a study of the chemical composition and physical properties of American-tanned sole leathers, for the purpose of determining the influence of the method of tanning on the character and wearing qualities of the leathers.

In connection with the methods of kiln-drying lumber which are now extensively practised, the laboratory has been requested to make a study of the effect of dry and moist heat on the physical properties of various woods. The value of these data will be in their practical application in connection with the use of such lumber in buildings. This work has been held in abeyance until appropriate testing machines can be obtained, and we then propose to co-operate with the Road Material Laboratory of the Bureau of Chemistry, not only in this work, but also in the testing

of wood paving blocks and the application and effect of wood preservations. A large variety of the latter are to-day offered, and a comparative study of their effectiveness should prove of considerable value.

Another line of work, which will hardly be received with much pleasure by certain interests, wherein it resembles the work on food adulteration so long carried on by the Bureau of Chemistry, but which will be beneficial in other directions, is an examination of American turpentine as found on the market. It is claimed that adulteration, especially with benzine and rosin oil, is most extensively practised, the result being a pecuniary fraud by which both the buyer and ultimate user suffer, as paints prepared with such turpentine have less covering power and permanency. In a bulletin on oil of turpentine, recently published by the Inland Revenue Department, Ottawa, Canada, it was shown that 16 per cent of the turpentine sold in the province was adulterated in the manner just mentioned.

In connection with the turpentine industry, we are now engaged in a study of a series of products obtained by a new method of distilling waste pine. I will not enter into the details of the process, as they will shortly appear in a report which we are now preparing for publication in *Forestry and Irrigation*. I may say, however, that this process appears to be the first which successfully and profitably utilises the larger quantities of dead pine found in the southern turpentine belt.

Probably the most interesting work conducted by this laboratory is a study of the chemical composition, constituents, and possible uses of a series of tree secretions which have been submitted by the Philippine Bureau of Forestry. With the exception of a few of the materials, we have so far not been able to find a reference in literature, and in some cases the work has proved doubly interesting, as we have found investigations recorded which have been made with material of doubtful origin. This naturally introduces an element of uncertainty with reference to the applicability of the final results, and it is fortunate that the materials sent us for examination have in general been carefully identified. Arrangements have been also made whereby the laboratory will be supplied with samples of the various parts, such as the bark, wood, leaves, and secretions, if found, of all new trees reported by the exploring parties sent out by the Bureau of Forestry in Manila, and those materials will form the basis for a series of investigations having both a purely scientific and a commercial value.

In connection with these various problems we have also planned a series of microscopical studies of woods and barks, and work of this kind is now progressing with reference to the oaks previously mentioned. The object of those investigations is not merely histological, as we are aware that considerable

work of this kind has been done. Our chief aim is to study the histo-chemistry of the cellular structure, and a number of interesting observations have already been recorded. A large amount of microscopical work will also be required in connection with the investigations on wood-pulp and papers.

During the coming spring the laboratory will also conduct an investigation on chemical methods of killing useless timber.

Finally, I may mention the study of analytical methods, especially with reference to tanning materials, which is conducted each year in connection with the association of official agricultural chemists. It is not so very long ago that the American tanner or extract manufacturer considered a chemical analysis to possess no value whatever, and preferred to buy and sell on the basis of the density of the material. This state of affairs was chiefly due to erroneous methods of analysis and the lack of uniformity even when the same method was followed. Through consistent effort and study on the part of a number of chemists interested in the subject this has been changed, and at least 75 per cent. of the tanning extracts and materials found on the American market to-day are sold on the basis of an analysis by the official method. At the last meeting of the Association, it was agreed generally that this method is now practically perfect, and it was therefore decided to take up the study of other analytical methods applicable in a tannery, the object being to eliminate the sources of error now existing. The ultimate aim of all this work is the adoption of an international method for the analysis of tanning materials which will be of service to the American importers, as the European chemists are now using a method which gives to an extract of tanning material a valuation from 1 to 2 per cent. higher than the official method."

The New "Para Rubber" from the East.

At a recent auction sale in London, six cases of fine rubber from Ceylon, the product of cultivated trees from Pará seed, brought 3s. 4½d. or about 81.4 cents., whereas the highest price for real Pará rubber reported during the week was only 3s. 0½d. per pound. This is not the first instance of exceptionally high prices obtained in the London market for "Pará rubber" from plantations in the East. The declining profits of coffee growing have forced the planters in that part of the world to seek some more remunerative planting, and already thousands of acres are covered with the rubber trees under cultivation. Not unnaturally attention has been turned chiefly to the Pará rubber on account of the universally higher price which it commands, and now that the first trees planted are becoming productive, the result of the sale of every little lot exported seems to planters to confirm their choice. There is no computing how much planting of Pará

rubber since 1900 has been due to the sale of 327 pounds, sent from Perak to London in that year, at 3s. 10d.

It is not impossible that these planters may yet be disappointed, for the reason that it remains to be seen whether what they are producing is really "Pará rubber." The tendency in nature is for all species to be influenced by a change of habitat. It appears, for example, that trees of the genus *Hevea*—the source of Pará rubber—when grown in the East, become productive at an earlier age than in the Amazon valley. Again, it is stated that while in the Amazon forests the seed pods of the *Hevea* uniformly contain three seeds, the number is irregular on the trees in the Malay States, and there are other indications of a tendency to "sport." It is possible that, under cultivation, the tree might in time develop different characteristics even in the Brazil, where thus far it has existed only under natural forest conditions. Ultimately new species of *Hevea* may exist, as a result of change of soil and climate, and of transfer from forests to plantations.

We have already expressed our opinion of samples of the cultivated rubber from the Malay States, which, while attractive in appearance, do not really resemble the fine Pará rubber now in use. It is much softer than the Brazilian product and of much shorter "fibre." It could not be used, for example, in thread elastic bands, or any fine pure gum goods. In solution it quickly loses its tenacity, so that it would not do for high grade cements. And it readily softens with age. Perhaps some of these defects might be removed by introduction in the East of the methods of coagulation employed in the Amazon rubber camps, but we are disposed to believe that the Eastern planters have really produced a new grade of rubber, and that the Pará article can never be wholly duplicated by them. It is to be understood, of course, that the rubber is valuable, and will find a ready market at a price which is likely to yield a profit, but such samples as have reached us, valued from the manufacturer's standpoint, would rank at least 25 per cent. below fine Pará.

The good price realized in London, doubtless, have been due to the cleanly appearance of the new rubber. And they have been based on the judgment of brokers, rather than results of practical tests in the factory. It would seem that the better course for the planters' associations would be, not to try to find how much money can be obtained in the open markets for their sample lots—which then become lost to sight—but to send them direct to a well equipped factory, to be made up in various forms of goods. The manufacturers' test is the one by which the value of this rubber will be judged finally, regardless of what may be the judgment of brokers to-day. We do not mean to dampen the enthusiasm of the planters, but there is such a thing as basing their plans upon estimates of profits that are impossible.

—*The India Rubber World.*

A Remarkable Oak Tree.

We have received from Wright and Turner, timber merchants, of Norwich, a photo of a section of a remarkable oak tree. The tree was blown down at Berghapton, Norfolk, in the gale of 1895, and it will be seen that there are two distinct growths of both heart and sapwood. In the centre we have the usual heartwood surrounded by a ring sapwood, but the extraordinary feature occurs in that we have a further deposit of several years' growth of heartwood on the outside of this first ring of sap, and this is followed by the ordinary outter rings of sapwood, immediately under the bark. We are informed that this singular formation extended throughout the trunk and to all the limbs of the tree; and for some distance from the ground line upwards there existed a network of fibre upon the outer surface of the inner sapwood as though ivy had grown round the tree previous to the second formation of heartwood.

Although this freak of nature is very uncommon, and probably few merchants have come across it in their experience, it is not unique. About 12 months ago we saw a similar thing in a tree felled at Naphill Common, near High Wycombe, but the fibrous network was not noticeable in this instance, and we should be pleased to hear from anyone who has seen a similar thing, or other interesting natural abnormities.

Several theories may be advanced as the cause of this deviation from an almost unvarying development. It is evident that on reaching the outer edge of the inner sapwood that the tree ceased growing for perhaps several season, and then from some reason or other it was restimulated into growth, and Nature then seems to have forgotten her functions of converting the sapwood into heart, and started afresh altogether. It may be that the traces of a fibrous network were formed by the bark being overlooked, like the sapwood, instead of arising from ivy, as suggested.

Perhaps the stoppage of the tree's growth was due to a cycle of dry seasons, such as we have experienced during the last few years, and that at its conclusion the fertilizing influences of the fallen foliage were acted upon by such an uncommonly wet season as we are apparently passing through at present, causing a reinvigoration of the soil, and spurring slumbering Nature into renewed activity. Or it may be that during its early stages this tree was shut in by others away from the influences of the sun and air, thus preventing it from obtaining the requisites for all expanding growth and stultifying it for a time. The removal of these enclosing trees would let in fresh light and air, and the tree not being dead would spring forth again, endowed with a new lease of life. This latter explanation we should consider most probable owing to the fact of the tree blowing down, it being very seldom one hears of an oak tree blowing down, even during

during a very severe storm, unless it is a tree which has grown up amongst others, and has been comparatively recently isolated, and, therefore, loses the resisting power of the other trees, upon which it had up till then been able to depend. But upon counting the concentric rings we notice that the new growth had extended over a period of rather more than 30 years, thus showing that if the theory of isolation was the case, the tree must have stood alone for quite this length of time; but oak is a slow growing tree, and it is very doubtful if in this time it would have been able to have secured for itself such a foothold as it would have had had it grown independently from the first.

Then, again, frost is a greater agency in altering the formation of tree than many people would suppose, and a severe frost in the autumn before the sap had entirely disappeared might, by the force of contraction, have so separated the bark from the timber as to lead to an altogether new deposit of wood; and to substantiate this theory we may mention that the medullary rays are intact throughout the whole of the sections, thus showing that while the main arteries are left unaffected, the annual processes received some rude shock, throwing Nature out of its prescribed habits.

It is highly probable that the inside of the tree, or we will call it the inside tree, might not have been in a state of actual life while the outer tree was growing, and to prove the possibility of this it is scarcely necessary to mention that a very large number of hollow trees are in a state of thriving life with a far greater proportion of the internal timber absent than is represented here, many of them, in fact being mere shell; an equally wonderful, although more common, example of Nature's idiosyncrasies.—*Timber Trades Journal.*

THE INDIAN FORESTER.

Vol. XXVIII.] October, 1902.

[No. 10.]

A Visit to "Olifants-Bosch," the most Southerly Mountain Forest of Africa.

*By D. E. HUTCHINS, F.R. MET. SOC., Conservator of Forests,
Cape Town.*

ALL that day at Grootvaders Bosch it had rained incessantly with a little hail; the feel of the air indicated snow on the mountains. At sunset it cleared, and I rushed up the mountain slope facing the farm where we were staying, to stretch my legs and see what snow had fallen. It was the first snowfall this winter. My cyclical studies had led me to expect a good deal of snow. A climb of 800 or 900 feet brought me to the level of the plateau above. In a hollow valley to the left lay about 600 acres of worked out indigenous forest. Above stretched the long line of the Langeberg Mountains, peppered with snow on the lower slopes and glistening thick and white with snow on the upper slopes: away to the west at the head-waters of the Duivenhok River lay rugged mountains and a cloudy peak tipped with the light of the dying day glowing with rosy tints—a scene long to be remembered. Then a rush through the gathering gloom down the slippery stony slope, at the risk of sprained ankles and broken legs, to the light and warmth of the farm below, where ladies' society, supper and a smoke with my genial host closed a pleasant day.

Next morning we were off at sunrise, and drove all day in a Cape cart to the farm at the foot of the mountains, where lay the inaccessible forest called Olifants-Bosch (elephant's wood). Here my kind friends made arrangements for a start next morning at cock-crow, with their shepherd as my guide. I was informed that a stiff climb and a long trudge on foot over the mountain lay before me. Not many people had heard of the forest I was going to: few indeed had visited it. Next morning I got off as arranged, with my guide, who I found could not speak a word of English. After a stiff climb of $2\frac{1}{2}$ hours we were nearly abreast of snow level, which after yesterday's hot sun had retreated about 1,000 feet

higher up the mountain. There was the same Alpine prospect; only here I was much nearer the snow and could see how thick in places it lay.

As we reached the brow of the ridge I was startled by a sudden jovial shout from my guide. He appeared to be hailing a boon companion, and I wondered how he could be doing so in such a place. Looking up however I saw a herd of seven Rëbok bounding over the rocks and heather, much like springbuck on the plains. He explained that they were dozing in the morning sun and did not at first notice our approach. It was the close season, and I had no rifle with me. One could not help regretting it was not autumn instead of spring, and that the Cape Parliament would not choose to sit during the best part of the shooting season, thus detaining one at head-quarters. As the Rëbok bounded off, little of them was seen but the white under their tails. Elsewhere their brown coats fairly mimic the tints of the mountain-side. Why they should show this conspicuous white flag when in danger I have never heard explained. Most of the hares and many other animals in South Africa have the same fatal habit. It is difficult to account for it on the theory of mimicry of surrounding tints. Later we came across another Rëbok bounding across our path. He gave us a side view, and was scarcely noticeable though close to us.

After half an hour's further pull we reached the summit of our climb and looked down into a deep valley, here and there touched with forest along the watercourse. This valley ran into "Oliphants-Bosch," the object of our journey and day's work. It had taken us three hours steady walking from Mr. Vigne's farm to the summit ridge overlooking the Olifants bush valley. From the summit ridge down to the forest at the bottom of the valley took us half an hour more. Here, under the grateful shade of a fine oak tree and with a crawling mountain stream at our feet, we had breakfast off a sandwich and a drink from the ice-cold mountain stream. There was frost on the ground when we started. Now the sun was getting warm. The oak tree I found on enquiry marked the residence of a wood-cutter, who many years ago had made his home here.

The old wood-cutter's cottage is an ideal place for a camp. Of the cottage only a few scattered stones and the stone oven now remain. No trace of his vineyard is left: his peach trees are dried sticks, but an oak that he planted has grown and is now a forty-feet-high, spreading tree, with a trunk about two feet diameter. At this season, the spring equinox, it is just bursting into leaf and catkins. It stands on an ideal spot for a ten day's camp remote from the world. To the south is the steep bush-cutter's path down which we have come into this enchanted valley—the only entrance to the valley. In a horse-shoe shape tower the mountains around. To the east are rugged cliffs down which tumbles a little waterfall,

that loses itself in spray before it reaches the bottom. To the north lies the forest, spread out into two valleys, containing respectively about 300 and 200 acres of good forest and about an equal quantity of poorer forest clothing the stony slopes. These valleys are terminated by deep dark gorges, lying, even now, with the equinoctial sun at noon-day, in perpetual shadow. To the west lies the main valley, from which rushes the main stream with a roar and rush that is heard throughout the valley as it circles round and below our oak tree and away through the beetling gorges that close the mouth of the enchanted valley.

The following notes relate to what I saw in the forest. A peculiar interest attaches to this and the neighbouring "Oude-Bosch" forest, they being all that remain to-day of the indigenous forest that formerly extended along the coast mountains westwards as far as Table Mountain at Cape Town. The indigenous forest here reaches its most southerly limit, and gets into a climate of purely winter rainfall. The mean temperature will lie between 55° and 60° Fah. and the rainfall between 50 and 80 inches.

On the slope between the streams I noticed Assegai, Red Els, White Els, no Stinkwood, one Yellowwood only, all trees small. The curious feature, in the forest, and which I have seen nowhere else, was the growth of the "Berg Cypress" (*Callitris cupressoides*). The local name for it here is Cyprei, pronounced Sipré (phon.). Generally this tree is found alone, or in twos or threes, on the mountain-side, never reaching a large size, but a strong grower and free seeder that springs up again and again in spite of the veldt fires. Here at Olifants-Bosch I saw it for the first time growing as a tall tree in the dense evergreen indigenous forest. There were trees 14 in. and more with 30 ft. of bole. Attention is at once called to them by their remarkable bark, showing longitudinal striae crossed by others at a small angle with the regularity of lace work: younger trees had the fibrous bark of a conifer divided by numerous parallel deep furrows. Under the cover of the dense evergreen forest the side branches rot, but remain long in their sockets before falling out. This is the habit of the common cypress (*Cupressus sempervirens*). The wood of the Cape Berg Cypress is scented with a slight Cedar-like odour—not the strong scent of the Clanwilliam Cedar (*Callitris arborea*). There is a fair sprinkling of these Berg Cypresses in the Olifants-Bosch—an average of about two to the acre. Their heads show out above the low evergreen forest like the Yellowwood trees in forest of a better class.

Red Els (*Cunonia capense*) and Beukenhout (*Myrsine melanophloeos*) were the most abundant species in Olifants-Bosch. Then White Els, Wild Peach and Assegai (*Curtisia faginea*). I saw some healthy looking Yellowwood (*Podocarpus thunbergii*) saplings, but only one tree in the pole stage.

Of Stinkwood (*Greodaphne bulata*) there was abundance in the damper parts of the forest, but all as dominated sticks a few feet high. I saw not a single large Stinkwood tree. I found a few Assegai poles had been recently cut. There was no evidence of other working in the forest.

It is quite a second rate forest, very inferior compared to the forest of Knysna and the Amatolas. How far this is due to cutting and how far to altitude I cannot say, probably mostly altitude. At 3 o'clock the lengthening shadows warned us that it was time to turn homewards. Then followed a long weary pull back to snow-line. Three o'clock is not the pleasantest hour of the day in South Africa for hard work. Comfortable people are asleep at this time. However one thought of coffee and cigarettes ahead, of the cosy chit-chat round the evening fire: once up to snow level the freshening breeze soon banished languor. At times our path was scarped out of the steep mountain-side, where a false step would have hurled one down a thousand feet. And as the sun sank from power to the mellow beauty of evening, we wended our way homewards through masses of those splendid heaths for which these Caledon mountains are famed throughout South Africa. And here surely are the head-quarters of the heaths in all the world.

In the evening my host Mr. Vigne supplied me with further particulars of Olifants-Bosch. He said there were large Stinkwood trees there once. Yellowwood trees he is uncertain about, but the bush was worked for wagon wood for many years. At one time it was considered to belong to Tygerhoek and one-third of all the wagon wood got out was brought to the Vignes as royalty. Who raised the question of its Government ownership Mr. Vigne does not know, but the surveyor, Kuys, was sent out, and he took it away from them. It would take three days he says to explore it thoroughly. As a boy he knew it well. He once came home *viâ* the course of the Olifants River. It took him 10 hours instead of 3 by the usual way. It would be impossible to make a road to the forest by the gorges of the Olifants River, the cliffs are so steep. Sometimes they seem almost to close overhead.

Anthony Van der Riet, an old Hottentot, worked there for 8 or 10 years and had a house, vineyard and fruit trees there years ago. More than 80 years ago Jan, wagonmaker, another coloured man, took out wood by sledge along the road that now leads to Nethling's farm. Van der Riet brought down most of his wood in small pieces, and his children are said to have grown up stunted with the excessive labour. Probably all the large wood had been already cut out even in his time.

There was originally a Dutch station and soldiers on the spot where the farm Tygerhoek now stands: and probably the lower forest and some of the best wood in Oude-Bosch was worked at that time. The beams of the old part of the present homestead are of Yellowwood.

Thus ended my first (and probably last) visit to this remote forest, lying in its secluded glen, high up among the winter snows in the most southerly mountain range of the African Continent.

II.-CORRESPONDENCE.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Extract from a Report on East Indian Walnut (*Albizia Lebbek*), with notes on Forest sowings.

By G. M. RYAN, Deputy Conservator of Forests, Central Thana.

Albizia Lebbek grows in the evergreen mixed forests in the Sub-Himalayan tract from the Indus eastward in Bengal, Central and South India, Burma and the Andamans, ascending to 5,000 feet in altitude (*Dictionary of Economic Products*). In the Bombay Presidency it is found in the Forest Divisions of—

1. West Khandesh.	}	Deccan.
2. Nasik.		
3. Poona.		
4. Satara.		
5. North.	} Thana.	} Konkan.
6. Central.		
7. South.		
8. Kolaba.		
9. North Kanara.	}	Kanara.
10. South Kanara.		
11. Surat.	}	Gujarat.
12. Panch Mahals.		

It is never apparently found abundant in any one forest, nor is it gregarious, but it is important to note that the tree is indigenous to the forests of the Presidency (excluding Sind).

The main reason why the tree fails to reproduce itself naturally in the same abundance as other species is due, it is believed, to the attacks of certain minute insects, which bore into the mature seeds. Not only do the insect's attacks occur after the pods have fallen from the trees apparently, but the damage has been observed to seeds while in the pods freshly gathered from the trees. This may seem extraordinary, but it is feasible of explanation in this way: The pods appear early in the fair season after the rains in Thana, and after ripening they remain hanging on the trees for several months. In the Panch Mahals I have seen the dry straw coloured and almost flat pods hanging on the trees in April-May, although they first appear sometimes in January. This lengthened attachment of the pods of trees would add of course to the difficulties of natural reproduction, for if the rains were at all early, as they very often are, many of the seeds, even if sound, would never reach the ground in time for germination probably.

The above factors would appear to militate against reproduction of the tree in the forests, and an inspection of the localities where it grows has proved the absence of natural regeneration, and also that there is probably some agency, such as birds, by which the seeds of the tree are dispersed. In the midst of dense deciduous forest sometimes a small tree will be met with standing quite isolated, and perhaps for miles round there may not be another growing.

It is as well to add that I have consulted Mr. Nicéville, the Entomologist of the Indian Museum, Calcutta, about the injury to the seeds, and after an inspection of several of the pods I sent him, he remarks :—

“ I have examined all the pods of *Albizia Lebbek* you have sent me, and find that about 50 per cent. of the seeds have been attacked by a minute lepidopterous insect. The damage done, therefore, does not seem to me to materially nullify the natural reproduction of the tree. All the moths have, I believe, emerged, so I fear there is no chance of my obtaining the perfect insect so as to enable me to identify it.”

With all due deference to Mr. Lionel de Nicéville I submit that the damage seems to me serious enough to interfere with the natural reproduction of the tree in the forests. The seeds that are damaged have all, or nearly all, the cellular interior removed, leaving an hard outer rind.

If to the 50 per cent. of such damage is added 30 or 40 per cent. on account of damage from fires and birds, it can be judged how natural reproduction must be obstructed. Seeds damaged by insects have, it may be mentioned, been sown and have failed to germinate.

It is evident something must be done to circumvent the insects' attacks. The remedy lies in seed being collected as soon as the pods have ripened, and this can be observed from their appearance, the uninjured ones being of a light straw colour free from all outward blemishes. It seems from what Mr. Nicéville says, that even when this is done a certain number of the seeds may still be found damaged, but the damage will not be by any means so extensive as when the seeds are left to be gathered later.

ARTIFICIAL REPRODUCTION.

Except as a roadside tree in Belgaum, Khandesh, Sind and other places, as indicated, the tree has not apparently been artificially reproduced anywhere except in the Mauritius, where the tree has been introduced, and it may be seen covering the hills. Evidently the insect which attacks the seed in India does not live in Mauritius. In Poona the Divisional Forest Officer states: “ The

seed has been sown without result, but that further necessary operations are being tried." As a roadside tree it has been extensively planted, apparently mainly because of its swift growing habit, and the Deccan seems to be the tract where it best flourishes in this manner.

In the rains of 1899, about 3 pounds of the seed were sown in the forests in South Thana, and in 3 weeks the seeds germinated. In spite of the severe drought which followed (famine resulted nearly all over the Presidency proper) several of the seedlings survived, and in January 1901, *i.e.*, one year and 7 months after sowing, 14 plants were alive and vigorous, the largest being 7' 6" high, with a girth measurement of 2½" at 2 feet from the ground.

The system adopted was direct sowing (*a*) in pits, which were dug 3' × 3' about the first week in May and left exposed for about a month, and filled in shortly before the fall of rain with fine earth; (*b*) in circular mounds, the earth being loosened with a crowbar at a depth of about 6", shortly before sowing.

Fully 80 per cent. of the seed sown in the manner indicated under (*a*) germinated, and far more of the plants than exist would have survived but for the protracted and severe drought. Subsequent operations have not been undertaken, for during the rains of 1900 I was on famine duty in the Panch Mahals.

The results under (*b*), which is in force and which has been in ninety-nine cases out of a hundred in Thana for some years, were *nil*, not only because the method is useless in the regions of trap formation, but because a large proportion of the seed sown by the Guards was sown without examination. Not only is the method under (*a*) suitable for direct sowings of *Albizzia Lebbeck*, but I venture to say that if adapted in the case of other kinds of seeds also, it would be found to produce successful results.

It is not of very much use merely digging up the soil to the depth of a few inches (6" to 1') or ploughing it, as is often done. This mere scratching of the surface in the coupes in Thana, especially in the treeless tracts, is one main reason why the direct sowing system, it is thought, has hitherto been so unsuccessful.

A large number of seeds if sowed germinate, it is true, under this plan, but as soon as the hot weather sets in, seedlings wither and die. The Forest Guard will tell you from want of water, and no doubt water is needed, but it is absurd, as is known, to think of watering plants sown under the direct method.

What is required is that in blanks and open glades sought to be restocked with valuable species, the method adopted should be that suggested under (*a*)—(1) in order that as large an amount of oxygen may be introduced into the soil intended for the roots

of the seedling; (2) that the growth of the latter may make rapid progress downwards and have no obstruction, such as root-lets, &c., below; and (3) have their tap-root as far removed as possible from the effects of the rapid evaporation of moisture that takes place from the subsoil during the hot months.

The seedlings when about four to five months old (say by November) should be covered by conical-shaped grass hoods about 2 to 3 feet high, with openings to the west, to permit them to breathe, so as to further obstruct evaporation of moisture from the soil and also transpiration from the leaves.

In the central and eastern parts of Thana, where the climate is dry and the heat excessive from February onwards, the transpiration from the leaves of plants is very heavy, the moisture from the soil being taken up and quickly evaporated from the surface of the leaves, the process resembling almost that of a pump. Unless, therefore, this is checked in the manner alluded to above or repaired by watering, it can be easily seen how young plants will wither and die as soon as their roots have absorbed all the moisture in the subsoil surrounding them. This remark would apply of course to most parts of the Deccan and Gujarat and Sind. Wardian cases, it may be mentioned, which are used for the transport of living plants over long distances by sea and land, are arranged on the principle that a plant can consume its own moisture during transit and does not need watering, that is to say, the amount of moisture transpired by the leaves is not allowed to escape, but is re-utilized by the plant. It is interesting to note how nature herself also adapts this system, i.e., economizes moisture to the greatest possible extent in dry climates, for the tendency is for plants to increase the prickles, hairs and other productions of the epidermis in such situations.

This attempt to obstruct evaporation as much as possible from the soil, &c., and transpiration, are factors which Forest Guards do not understand and will not, through habitual laziness, give effect to. Bearing in view the vast amount of economy that results under the method of direct sowing as opposed to transplanting from nurseries, the measures suggested should be insisted on. If these steps are not taken, watering the plants in the hot months is the only alternative, and this, as already stated, is too expensive, and in many cases an impossible process, because water is not always available in or near the locality of the sown area.

It is not easy to get a Guard to make and maintain the straw coverings for the seedlings, but experience has proved that he can look after at least 30 in this manner, and if each Forest Guard rears on an average even 20 plants successfully in open glades annually, in a division where about 100 men are employed,

2,000 plants of valuable species annually will have been established without any expenditure.

It may be easy to generalize in this manner, but systematic cultural operations, it is thought, are not and, often it is true, cannot be carried out invariably, and a Forest Guard, if left to himself with general instructions to act upon, endeavours to show either too much sowing and planting work in a season in order to try and prove his zeal, &c., which results in ultimate results being *nil*, or to collect and sow seeds of species that are useless and valueless for restocking the exploited coupes. Repeated experience of this kind has led to the preparation of a sort of working plan for cultural operations for each round in the Vada Range, Central Thana, fixing the kinds and quantities of seed to be collected at each forest post in it, the periods during which different seeds appear and are to be gathered, &c., and the method of storing and sowing the seed. Seeds of valuable and really marketable species only, with which it is required to stock the exploited coupes during the current and ensuing rotation, are collected and sown under the method, and what is also important is that on a change of the *personnel* of the executive or superior staff, the new officer has the benefit of the accumulated experience of his predecessors to depend on. It not unfrequently happens that the experience gained by one officer is lost with him on his departure from the district, and this ought specially to be guarded against in regard to sowing, for it often takes some time for experience to be acquired as to the best method of sowing in a particular district. In parts of Sind, for instance, such a system as obtains in Thana would never suit, and it might be the same in the Deccan or Gujarat; but from what is known of the Deccan, the geological formation of which is trap, the same system as succeeds in Thana would probably succeed in many places there. However, whatever is known to be the best system in any particular locality should be seized upon for adoption and laid down to be followed.

V.—SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

By F. FINN, B.A., F.Z.S.

CHAPTER IV.

THE LONG-TAILED PHEASANTS.

(Continued from p. 351.)

Of the various long-tailed types of pheasants, the true Argus is certainly the most remarkable, the genus being quite unique among birds in general. The most important characters, in addition to the bare head and long secondary quills mentioned in the previous chapter, are the rather long legs and the tail, which is folded like that of a common fowl and composed of only 12 feathers. It is only moderately long in the hen, barely exceeding the wing; but in the cock the middle tail feathers are of enormous length, up to over four feet. In this sex also the secondary quills, which are very broad as well as long, exceed the primaries by considerably more than a foot; even in the hen the primaries are some inches shorter than the secondaries.

THE ARGUS.

Argusiannus argus:—Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 71.

Native names:—*Quou*, *Burong quou*, *Kwang*, Malay; *Kyek-wah*, Siamese at Bankasoon.

The plumage of this bird would be very difficult to describe in full, but it is not hard to briefly characterise. In both sexes it is mostly of a dark brown, closely mottled with buff, the breast being of a plain bay; the bare head is blue, and the legs red; the cock has no spurs.

As above noted, he differs from the hen in his enormous secondary quills and central tail feathers, the latter being curiously twisted at the end. The male Argus's wing quills, also, both primary and secondary, bear the elaborate decoration which makes him one of the most wonderful birds in the world, but none of this is visible in the ordinary attitude of repose. The primary quills have a dark blue shaft, and a band of chestnut finely dotted with white alongside it on the inner web of the feather; the secondaries have along the shafts of their outer webs a row of most beautiful eye-spots or "ocelli," shaded with ochre, drab, and white, so beautifully as to resemble balls lying in sockets, the "lights" being most artistically rendered. As Darwin has shown, on the plumage of this bird a complete gradation can be traced from these wonderful markings to ordinary spots. Another peculiarity of the male, concealed in repose, is that the lower part of the back is buff with black spots.

The male is altogether larger than the female, and his extravagant developments of plumage make him seem even bigger than he is. He is about six feet long, with a tail of over four feet; the wing to the end of the great secondaries is nearly a yard long, but the primaries are only about a foot and a half, the shank is four and a half inches long, and the bill rather more than one and a half. In the hen the length is about two and a half feet; the wing a foot, and the tail an inch more; the shank is about an inch shorter than the male's. Her general appearance somewhat suggests both a fowl and a turkey.

In our empire this bird is only found in the extreme south of Tenasserim, but it inhabits the Malay Peninsula generally, as well as Sumatra and the Laos mountains in Siam. It is a true jungle bird, confined to evergreen forest, and hardly ever seen, as it is very wary and a great skulker. There appears to be no regular breeding season, nor do the birds associate in pairs or families. The hens wander about casually, and the males remain near clearings, which each makes for himself, picking all the weeds, leaves, &c., off an area a few yards square. In this he generally lives, roosting at night on a tree close by, and going out to feed on fallen fruit and insects.

Here, too, he is too frequently captured by various poaching devices in the way of snares and deadfalls, for there is a considerable demand for his beautiful plumage. A good many birds also seem to be taken alive: they are very quiet and easy to tame.

It is in this arena, presumably, that the cock displays himself to the hen, for he has a most remarkable and elaborate display, which requires a good deal of space. This has frequently been witnessed in captivity. I have seen it more than once myself. The cock, when at full show, spreads his wings to their fullest extent, at the same time bringing them down in front till they meet before his head, while behind they are elevated so as almost to meet in front of the raised, spread tail, the whole effect being of a great, painted, almost vertical screen or fan, hiding the head and body completely. The bird, however, who is careful to have the hen in front of him, every now and then pushes his head between two of his quills to see what effect he is producing. The said effect, in the cases I have observed, was absolutely *nil*; but very likely a captive hen, confined always with the male, is bored and indifferent. I did not see the peeping *manceuvre* on his part, but traces of its frequent performance may be found in the worn quills in skins.

The Argus does not seem to fight at all, and has been observed to give up his cherished parlour to an aggressive Fire-back pheasant without a struggle; but our old bird at the Calcutta Zoological Garden will fly at a hand presented to him, striking with bill and feet. In a wild state the males answer each other's calls. The note is a very curious one for a bird, a sort of double whoop, somewhat recalling the note of the Hoолоck Apes, though not so rapidly repeated as theirs. The hen has a note of several syllables, more quickly uttered, but of somewhat the same type.

She seems to lay at any time, the eggs being seven or eight in number and reddish buff in tint. Although the nest is, as usual, on the ground, the young fledge sufficiently to fly and take to a perch in a very few days.

The Argus, as it can hardly ever be *seen* wild, to say nothing of being shot, is rather out of court as a game-bird; but it has considerable value as a menagerie specimen, live birds fetching about thirty rupees each in Calcutta. It seems to me, therefore, that snaring in such a way as to cause its death should be prohibited, and its capture in any way regulated, as, if preserved, the high price it fetches would render it a profitable as well as harmless inmate of our jungles. It does well in captivity, and is easily tamed.

Only one other species of true Argus is certainly known, Gray's Argus (*Argusianus Grayi*) from Borneo, which is rather smaller than our bird, but does not differ much from it otherwise.

There is in existence, however, a piece of a primary quill feather, now in the British Museum, on the evidence of which a presumed third species has been named (*Argusianus bipunctatus*.)

the double-spotted Argus. In this specimen the white dotted cinnamon patch is found on both sides of the shaft, which is slighter than that of a corresponding quill from the common Argus. It is not known what the other feathers of this specimen were like or where it came from, and it might have been merely a "sport;" if so, it was certainly a progressive one, tending to greater ornamentation than the ordinary species possess.

We have next to consider the Peacock Pheasants, or *Polyplectrons*, which are rather small birds as pheasants go, with long legs and short, rounded wings and long flattish tails, composed of as many as twenty broad rounded feathers. The upper tail coverts are also very long and broad. The general build is light, and the birds are very active. There is a bare skin round the eye in both sexes; but the female is smaller and less bright than the male, and is not spurred, whereas the male has more than one spur on each leg, whence the scientific name, which means "many spurred."

Only one species is certainly known as occurring in our empire.

THE GREY PEACOCK PHEASANT.

73. *Polyplectrum chinquis*. Blandford, Faun. Brit. Ind., Birds, Vol. IV, p. 73.

Native names:—*Paisa-walla majur*, Cachar Tea Garden coolies; *Munnawur*, *Beyodahuk*, Assamese; *Deodurug*, *Deo-dirrik*, Garo Hills; *Kat-mor*, Chittagong; *Doun-kalah*, Arrakan and Pegu; *Shwe-dong*, Tenasserim.

The male of this species has a rather short, hairy-looking crest, always standing on end; his tail is several inches longer than the closed wing. The general plumage is a grizzle, produced by numberless tiny cream-coloured spots on a drab ground, but the throat is pure white, and the back, wings, and tail studded with eye-spots of green shot with purple, and bordered with cream colour. "Studded" exactly represents the effect, for so beautifully shaded are these spots that they seem to stand out from the feather like convex bosses of metal. They are round, small and single on the back and wings; large, oval and double on the tail and its upper coverts; in all cases being near the tip of the feather. His bill and legs are dull black, eyes white, and face pale sickly yellow.

The hen is considerably smaller than the cock, and has the tail much shorter even in proportion, this being less than two inches longer than the wing in her. In general style of plumage she resembles the male, but has a shorter crest, is duller and darker in colour, and has, instead of eye-spots, ill-defined black patches, with only a faint gloss of green. On the longest tail feathers and

their coverts even these poor apologies for eye-spots are absent. Her bill, legs and face are less decided in colour, and her eyes grey.

The male is just over two feet long, with a fourteen-inch tail and wing of over nine inches; his shanks are three inches long, provided with from one to three spurs each; his bill about an inch and a half from corner of mouth to tip.

The hen is only nineteen inches in length, with a nine-inch tail, and wing of less than eight inches; the shank is only about a quarter of an inch shorter than her mate's.

The Peacock Pheasant ranges from Sikkim through Assam and Burma to Siam, always keeping on or near hills, though not a bird of high elevations, as it seems not to range above six thousand feet. It frequents thick jungle on hillsides and ravines, and is very wary and hard to approach. The male has a most unpleasant call, a kind of harsh barking cackle, and will often reply to a gunshot with it. In showing off to the female he manages to display all his beauties at once, by raising one wing and lowering the other, at the same time spreading and slanting his tail, so as to exhibit all his spots on the side turned towards her. In captivity he is true to one mate, and she displays an interesting method of protecting her chicks, keeping her broad tail spread horizontally as a sort of natural umbrella to hide and shelter them as they follow her. They, in their turn, have the instinct to follow closely, so strongly developed that when specimens were hatched under a Bantam fowl at the London Zoological Gardens, they persisted in running close behind her. In this way they got more kicks than cover, and it was not till the Peacock Pheasant herself hatched chicks that the habit was understood.

The eggs of the Peacock Pheasant are buff-coloured and about two inches long; tame birds only lay two. The wild ones nest about May.

It is possible that another species of Peacock Pheasant may occur in Tenasserim, since one is found in the Malay Peninsula. This is the *Polyplectrum bicalcaratum*, the male of which is speckled with black instead of cream-colour, and has a longer crest glossed with purple and green. The hen is also easily distinguishable by the dark instead of light speckling.

Moreover, Mr. Hume got in a Lushai village some tail-feathers like those of a third *Polyplectrum*, the *P. germaini*, whose known home is Cochin China. Germain's Peacock Pheasant has no crest at all; its plumage is light speckled, but darker in tone than in our gray bird, and the eye-spots on the tail-feathers are longer. In the hen the eye-spots are better developed than in that of our species, and are found on the longer tail

coverts. The males, at all events, of both these Peacock Pheasants have the bare skin of the face red, so that a red faced Peacock Pheasant in British territory is a bird to keep one's eye upon.

These birds as a group are more interesting to the bird fancier than the sportsman; they are not difficult to tame, the skulking habits which render them objectionable as game being evidently the outcome of an intelligent appreciation of their circumstances, for a disposition to lay aside fear in domestication is characteristic of many birds which are inveterate in their love of cover in a wild state—the above-mentioned Argus for example. The singular and unique beauty of the males of these birds would, however, always justify the keeping up of a large stock of them as suppliers of ornamental plumes, if they could be protected against wasteful destruction on this account.

The Destruction of a Rogue Elephant in the Andamans.

BY C. A. ROGERS, F.C.H., *Deputy Conservator of Forests.*

ON the 14th February 1889, the largest and most powerful of the Andamans timber-dragging elephants, called Napier, escaped from his mahout at the forest camp on the Pochang stream, which empties itself into Shoal Bay Creek in the South Andaman Island. He had become *must* and had broken away from his keepers and run away in the forest.

Napier remained in the forests about the Pochang camp for some months, and two attempts made to recapture him by the help of female elephants during the hot weather proved unsuccessful. When the rains set in and water was abundant everywhere Napier must have gone further afield, as nothing more was heard of him after the rains had been thoroughly established.

Napier must have wandered south through the forests, as on the 26th September following he was seen at Mihtakhari, about 15 miles south of Pochang and on the eastern shore of the Port Blair Harbour. He appears to have walked round the harbour, as he visited Aberdeen (the largest and most populous village in the Settlement, and the head-quarters of the Andaman and Nicobar police, as well as the residence of several Settlement Officers) on the south side of the harbour, and to have killed a native near the Aberdeen jetty. After this he walked north along the main road to Haddo, where he was fired at by the police guard. He was only frightened by the volley and went off into the Minnie Bay jungle to the south-west of the penal settlement of Port Blair.

On the 28th and 29th September he visited the Minnie Bay tea garden and did but little damage except frightening the natives whom he met.

Napier appears to have swam across the Port Blair harbour on the night of the 1st October, as he was seen at Bamboo Flat on the north side of the harbour on the 2nd October, and their must have walked along the north shore of the harbour to North Bay, as he damaged the convict barracks at that station and, continuing his wanderings in a northward direction, amused himself on the 3rd October by pushing down the walls of the new salt factory, which was at that time in process of construction. On the 5th October he appears to have visited Aberdeen again, but to have done no damage; and then he retired to a small island near Mihtakhari on the west shore of Port Blair harbour. He was watched here for a few days, but eventually broke away into the swamp which surrounded the island, and, though fired at by the police, made good his escape into the Mihtakhari forest.

Napier was then proclaimed to be dangerous by the Chief Commissioner, Colonel Cadell, and orders were issued that any one might shoot him. Two Settlement Officers, *Captain Thornhill*, I.S.C., and *Mr. Jessop*, followed him up into the Mihtakhari forest, but did not succeed in killing him, and he soon after disappeared from the immediate neighbourhood of the Settlement.

The next year Napier appeared at one of the outlying villages of the Settlement and was fired at and at once disappeared.

In the annual report for 1891-92 it was suggested that Napier must have been killed in the cyclone which swept across the island on the night of the 1st-2nd November 1891, when the Royal Indian Marine ship *Enterprise* broke away from her anchorage and was wrecked on the Sesosteris Reef.

This, however, did not prove to be the case, as Napier appeared at the Pirij forest camp on the east side of Shoal Bay Creek in July 1896. Another attempt was then made to capture Napier, and he was decoyed by means of one male and two female elephants for some 14 miles through the forest, when one night he suddenly became suspicious, and after having fought with and severely punished the male elephant, ran off into the forests of the Cholangi Ridge and was not seen again. On the 6th August 1899, Napier came across Virginia in the forest near Boratagajig and injured her so badly that she died; and on the night of the 11th August he visited the forest camp at Boratagajig on the west shore of Shoal Bay and frightened the Forest Department elephants so much that three of them broke their fetters and ran away into the jungle. They were recaptured a few days afterwards. On the 15th August Napier fell into a pit which had been dug for him, but owing to the pit not having been made deep enough, he got out of it by the aid of a stump of a tree which had been left within his reach, and disappeared.

He was followed up by Deputy Ranger Hussain Ali on the 24th August, and a further attempt made to noose him, which proved a failure.

In consequence of Napier's visit to the elephant camp at Boratagajig, it was deemed necessary to construct a strong stockade around the elephants in order to protect them from similar attacks in the future, more especially as several of the elephants had been roughly handled by Napier, and they were all very much afraid of him.

On the 14th August 1900 Napier again appeared at Boratagajig, and on the 17th of the same month, while Mr. Heinig, Deputy Conservator of Forests, was at the camp, Napier broke through the stockade which had been constructed to protect the elephants, wounded *Kate* and frightened *Adolphus* and another elephant so much that they broke their fetters and ran away into the jungle. They were recovered, however, the next day. Napier was fired at by the police guard, and on the 23rd August left the neighbourhood of the Boratagajig camp.

The Forest camp was moved to Jatang in the spring of 1901, and on the 20th April of that year Napier also reappeared, but was driven off by the police firing their snider carbines at him. The next day four policemen and four convicts tracked Napier and fired at him. He turned upon them, but fortunately did not get hold of any of his pursuers, who left him and returned to the Jatang camp. Napier appeared at the camp the same night. He was followed up the next day and fired at from a *machan* in a large tree, but returned to the Jatang camp at night as usual. Deputy Ranger Mohan Lal reported that Napier had become very cunning and would not walk into pitfalls, and never came along the same path two days running, and asked that arrangements might be made to shoot him. These, however, were not made owing to the difficulty of getting suitable rifles, and the Jatang camp was abandoned on the 5th May, and the elephants and men moved across Shoal Bay Creek to Pirij, as no work was possible so long as Napier remained in the neighbourhood.

The Jatang camp was re-occupied in October 1901 after it had been ascertained that Napier had left the neighbourhood. Apparently he visits the forest camps when *must* in the spring and in August, and does not trouble them at other times of the year. Napier came back to Jatang on the 14th April 1902, and was seen standing on the far side of the nullah which winds around the spur on which the forest camp and elephant enclosure is situated. He appeared suddenly about 5 o'clock in the evening, and the police guard at once turned out, loaded their sniders with ball and moved down to the near edge of the nullah to prevent his crossing it and attacking the tame elephants. The nullah had vertical sides about 14 feet deep where Napier stood, and this effectually prevented his crossing over it to where the police stood.

The police fired two volleys at Napier at a distance of 30 yards, one while he stood sideways to them, and the other as he ran away in an easterly direction towards the jetty guard. He appears to have stumbled into the nullah on receiving the second volley, and to have followed it down to the jetty police guard about a quarter of a mile distant. The jetty guard fired another volley at him as he approached them, which turned him into the thick jungle, and he was seen no more. The police reported that they had hit the elephant 36 times, and that they had found some traces of blood on the ground, but it is evident from their report that the wounds inflicted were quite superficial.

The news of Napier's reappearance reached Port Blair on the 16th April 1902, and Colonel Sir R. C. Temple accorded his permission to an attempt being made to kill Napier, as the several attempts that had been made to catch him had all failed.

On the 24th April a party, consisting of Lieutenant W. G. A. Brett and Corporal W. Ward, both of the 2nd battalion of the Duke of Wellington's (West Riding) Regiment and myself, started from Port Blair in the steam launch *Eileen* for Shoal Bay, a creek about 18 miles north of Port Blair, into which the Jatang stream flows. The launch anchored off Pirij, another forest camp on the Shoal Bay Creek, and a rowing boat was ready to take us up the Jatang creek to the forest camp.

The weather was extremely hot and the sun simply poured down upon us as we slowly progressed up the wide creek, and then the narrow stream which succeeded it and meandered through a vast mangrove swamp, which, while it kept off what little breeze there was, did not afford us any shelter from the sun's rays, and we were, indeed, glad when the boatmen laid aside their oars and took to stout bamboos, with which they poled us up the last mile of the stream. The tide was against us, which made our rate of progress more than usually slow. At last we reached the jetty guard, landed and walked over felled surjan (*Dipterocarpus*, sp.) logs to the hillock on which the camp was situated, and very glad we were to rest in the bamboo hut which serves as a forest rest-house.

The news about Napier was not at all reassuring. He had not been seen since the day that the police had fired volleys at him, and he had only been heard of once or twice since that date.

In the afternoon we carefully studied Sanderson's book *Twenty years among the Wild Beasts of India*, to learn what we could of the habits of elephants, also the shots by which they could be killed, and when the elephants returned from their work in the evening, studied then carefully in order to make sure of the vulnerable spots so clearly described by Sanderson.

The next thing to be done was to test the sighting of our rifles, so we put up a target with a black triangular bull's-eye marked as to represent the ear shot which Sanderson says is the most fatal one.

We were armed with Lee-Metford rifles, kindly lent by Captain P. A. Turner, commanding the detachment of the West Ridings stationed at Port Blair.

The target was put against a log about 30 yards off, as the jungle was too dense to allow of any long shot being obtained, and we knew that if we did get a shot at all it would be at close quarters, so we wished to see if the rifles threw high at such a short range. Some of the bullets had had their noses filed off so as to expose the lead core, and we wished to see if this in any way affected their trajectory. We each fired two bullets, one ordinary and the other with the nose filed off, and all six bullets pierced the bull's-eye, and satisfied us on the vital point as to the correctness of the sighting of our rifles at very short ranges. The bullets with the filed noses did not make any larger holes in the log of wood than did the Service ammunition.

Napier did not turn up at the camp during the night, but early the next morning news was brought in by the road-making file that his fresh footprints had been found in a stream about half a mile from the camp. We at once started for the spot, picked up the fresh tracks in a new clearing that had been recently made, and after some little search, found the place, but Napier had broken out of the clearing and had made off into the thick jungle. Two convicts Naingul and Pershadi, accompanied us, and, together with two Andamanese, picked up the tracks, and off we went. I must confess that the Andamanese did not take kindly to this form of tracking, and that the convicts who were familiar with the ways of tame elephants really did the tracking. After following the fresh tracks for about two hours, we crossed a stream at which Napier had evidently quenched his thirst, and soon after came into some fairly open bamboo forest where he had been feeding, and we were in great hopes of finding him still here. Our hopes were destined to be disappointed, as Napier was not in the bamboo forest; so we sat down, rested, and had some food, while Naingul and Pershadi went a head into the thick jungle which succeeded the bamboo forest, to see if they could find any tracks of the elephant. They returned in about half an hour with the welcome news that they had heard Napier; so we at once started in pursuit and arrived at the place where he had been seen. We could not see him, but only heard him crashing through the tangled mass of creepers and young saplings which constituted the forest just here.

The current report about Napier was that he charged you on sight; so we got behind the buttressed root of a large tree, near

which we found ourselves, and awaited his onslaught. We heard him breaking down the saplings near us, but could not see him, and at last, as he did not seem to be coming nearer to us, we came out of our cover and followed after the noise he made crashing through the forest and soon got a glimpse of him. As we could not see his head we did not fire, but waited for him to turn on us. This he did not do, but suddenly turned and made off into the dense undergrowth once more. We followed in the lane he made, as the forest was elsewhere too dense for us to penetrate *without* cutting our way. The noise Napier made was tremendous, and the crashings of sapling and tearing of creepers was decidedly awe-inspiring. However, we could only follow him up in the path he had made for us, and this we did, and, after about half an hour's chase, we saw him again about 30 yards off, *but could not get a clear shot at him.* He turned as if to charge us, and Ward and myself covered him, but as neither of us were quite sure of our shots, and there were many branches between the elephant and us, any one of which might have turned our light bullets, we refrained from firing, as Napier thought better of his idea of charging us, and once more turned and made off into the tangled undergrowth. That was the last we saw of him that day. We followed him up for another half hour, and as we seemed to get no nearer to him, *we abandoned the chase, pretty dead beat,* about 1 o'clock, and, after a good long rest, proceeded wearily towards camp. Sugar had been put in our bottles containing tea by an inexperienced servant, so we had to choose between sweetened tea and such little pools of muddy water, and few and far between they were, with which to quench our thirst.

We reached camp about 3 o'clock and enjoyed such as only really thirsty men can, a long cool drink, followed by a hot bath and a siesta.

That evening, the 26th April, we were roused from our slumbers about 11 o'clock by the police guard, who had heard Napier in the jungle, near a small stockade which had been some time ago constructed with a view to entrapping him. This stockade was on the far side of the nullah and close to where Napier had stood when the police fired at him on the 14th April 1902. A pit had been dug across its entrance for Napier's benefit.

There was a bright moon, so we got up and waited for Napier to cross the nullah and come towards the large enclosure in which the tame elephants were picketted. We waited in vain. Napier remained in the shadow of the trees on the far side of the nullah, *amused himself by breaking down trees and digging up ant-hills,* but would not come into the open, and disappeared into the thick jungle just before day broke. He must have followed along the track we returned to camp by, probably out of curiosity.

The next morning we went to see where Napier had stood and what trees he had broken down. The trees were at the entrance

of the pitted stockade above referred to, so we decided to tie up a tame elephant inside the stockade and to sit up all night with her in case Napier, who was reported to be "*must*," should be tempted to try and enter the stockade, when he would have fallen into the pit. The stockade and pit had been made about a year ago, and creepers had grown all over the bamboo trelliswork which had been put over its mouth, and it was very hard to say where the firm ground ended and the pit began. The moon would rise about 9 p.m., so we had an early dinner and were in the stockade at sunset, ready for a night long watch. We had whitened the sights of our rifles with slaked lime, which made them fairly visible when the moon was bright. Each was to take a two-hour watch and was to awaken the sleepers, should their be any, if Napier turned up. Napier did not appear, and at daylight we retired to our hut and slept. We sat up on the night of the 27th April also, but Napier did not appear. On the morning of the 28th, just as we were retiring to rest, a convict came to say that the petty officer in charge of the tame elephants had discovered fresh footprints of Napier's at the stream where the tame elephants drank on their way to their dragging work, and asked if the elephants should be brought back to camp. I told him that the elephants should go to work as usual, and that we would come and see where Napier had been when we were sufficiently rested. After breakfast we started off with our rifles to look at the place where Napier had been seen and to arrange what we should do next. We followed along the elephant dragging path for about three-quarters of a mile, when on turning a corner in the path we found ourselves face to face with Napier. He entirely filled the path, was standing about 20 feet above us, and was 30 yards distant: we paced the distance afterwards. I was leading, so knelt down and covered him with my rifle, while Brett got his rifle and was ready to fire. The bullet in my rifle had its point filed off, that in Brett's was an ordinary Service bullet. Ward could not get a shot, so stood behind and watched the effect of our shots. As soon as Brett fired I fired. Both our bullets struck Napier on the head, mine on the right joint below the bump which forms the base of the trunk, and Brett's a little to the left of the bump and above it. Ward says that clouds of dust came out of the elephant's head when he was hit, and that he at once turned round and retreated as fast as he could. I ran after him, loading my rifle as I went, and got a sight of the elephant on fairly level ground as he was running away, and fired an ordinary bullet horizontally into the middle of his body. This bullet must have pretty well traversed his body and penetrated his lungs, as we found, on following up the wounded animal, that he had been coughing up red froth and pieces of some internal organ which looked like lung. We followed him for over two miles by blood. At first he bled copiously from both head wounds and then from one only. Napier went straight towards where the tame elephants were

working and we after him as hard as we could go. The tame elephants scented Napier when he got near, and the police fired two volleys of ball in our direction and at a close range before we could stop them, but fortunately did not hit any of our party. Napier turned back from the tame elephants and broke away into the forest between us and them, having turned back on his own tracks for a short distance, and on hearing us coming along his original track, he left it and turned away into the thick jungle. The bleeding ceased soon after this, so we left two convicts and two Andamanese to track him up as far as they could before night-fall and returned to camp. Naingul, the tracker, returned in the evening to say they had followed up the elephant for about one mile further, but had not seen him.

We started at sunrise the next morning, the 29th April, with food to last us all day, with the intention of having a long day after Napier, as we had to return to Port Blair the following day. Sanderson says in his book that he has never known of an elephant hit in the head with the front shot, which has not been dropped dead, being followed up and bagged, but as Napier had also been wounded in the body and had bled so profusely, we hoped that we might come up with him and kill him. Our party consisted of Brett, Ward and myself, two convict trackers, and two Andamanese. We walked rapidly to the place where Naingul had abandoned the chase the previous evening, and found that Napier had retreated along the same path as he had when Deputy Ranger Hussain Ali had followed him up in April 1901. This track took us over a low watershed into a stream flowing north, up which Napier had gone. He had evidently lain down in a deep pool about half a mile up the stream: he had gone further upstream, as we found his tracks for about a mile more, when he turned off into some thick jungle on the left bank of the stream, whither we followed him. After following his tracks for about a mile in this jungle, I sent on Naingul and one Andamanese to go quietly on and see if they could locate the elephant, as our party of seven naturally made a good deal of noise going through the tangled undergrowth which characterises the Andamans forests. About half an hour after Naingul and the Andamanese returned with the welcome news that they had heard the elephant, so we started after him once more, what wind there was being from him to us. After following his tracks for about half an hour we heard him moving on a slope above us, but could not see him. We waited for a few minutes for him to come and attack us, but as he did not, we cautiously advanced in his direction and we heard him again, and on reaching the top of a small ridge, saw his hind quarters distinctly in the jungle, so Brett and myself fired at him, as he was slightly below us. His hind legs seemed to give to the shots and he half sat down, exposing his head slightly. Napier then went away circling to the right, and Ward put two or three more shots

into him as he saw him indistinctly moving through the undergrowth. These shots turned Napier down towards a rather open stream, which he had to cross to enter the dense jungle on its far side. I jumped down into the stream and saw Napier side on about 15 yards off, and, getting a splendid shot at his ear, fired. The result exceeded my fondest anticipation. The huge animal leapt into the air, turned a complete somersault backwards and fell upon his head. Death must have been instantaneous. He never attempted to get up; but as his legs moved a good deal, we got on the bank above him and fired several more bullets into him to make sure that he was dead. A police orderly who was with me fired to or three snider bullets at the elephant at close quarters after he was dead, but they did not penetrate the skin, which shows that the volleys fired at Napier by the police could have done little if any harm. It was twenty minutes to ten when Napier breathed his last.

We sent for more convicts with axes and dahs and cut off the four feet for trophies, and, having seen this properly done, walked back to the Jatang camp, which we reached at 3 p.m. The feet began to arrive by 7 p. m., and we started back with the four feet at midnight for Port Blair, reaching our destination about noon on the 30th April.

The tusks were allowed to rot out, so as to ensure their not being damaged, and also to allow of the skull being brought in subsequently to see what effect the Lee Metford bullets had had on it.

The tusks were a wonderfully even pair and above the average. The dimensions are as follows:—

RIGHT TUSK.			Pt. In
Total length, outside curve ...	...	...	6 $\frac{1}{2}$
Length of part outside socket or nasal bones, outside curve ...	...	...	4 0
Length of part inside socket, outside curve ...	...	...	2 $\frac{1}{2}$
Greatest circumference ...	...	...	1 3
Weight ...	...	...	47lb 12oz.

LEFT TUSK.			ft. in.
Total length, outside curve ...	...	...	6 $\frac{1}{2}$
Length of part outside socket or nasal bones, outside curve ...	...	...	4 .1
Length of part inside socket, outside curve ...	...	...	1 11 $\frac{1}{2}$
Greatest circumference ...	...	...	1 3
Weight ...	...	...	47lb

The skull was brought into Port Blair on the 18th July, and a careful examination showed that the two shots we had fired at his forehead had not penetrated the bone of the skull. The only mark on the skull was the shot which had killed him. This had penetrated the brain one inch behind the hole of the

ear, but had not gone through the skull. This bears out what Colonel Sanderson says about the front shot, and also that the solid bullet fired into Napier from behind as he was running away must have done him some internal injury, or he would have gone right away and we should have seen him no more. Judging from the size of Napier's foot, his height should have been 8ft. 2in.

PORT BLAIR; }
6th August 1902. }

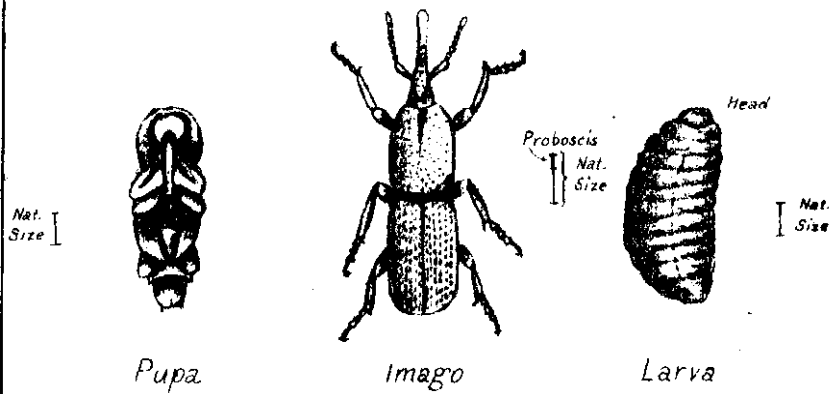
C. GILBERT ROGERS.

VI.—EXTRACTS, NOTES AND QUERIES.

An Injurious Weevil which destroys the Acorns of *Quercus incana*.

ON 11th June 1902 I collected a large number of acorns of *Quercus incana* at Mussoorie with the object of ascertaining what proportion of them were sound, as I could not account for the general absence of natural regeneration from seed of this species. The result of the investigation showed that about 80 per cent. were unsound. Some of the acorns were collected from trees and others from the ground, where they had quite recently fallen. The unsoundness of the acorns was found to be due to the attack of a weevil beetle. Many of the acorns collected from the ground had round exit holes visible on the outside, and were quite rotten inside, the kernel being reduced to a powdery mass. Others which had no exit hole, on being cut open, were found to contain a white legless fat grub; others contained pupæ, and in one acorn cut open on this date, I found a mature weevil together with several pupæ. In acorns plucked from trees only larvæ were found. By keeping acorns in a box as many mature weevils as required were obtained. They continued appearing until the end of June. The pupal state only lasted a few days. There are no visible holes in the acorn except one exit hole made by the mature beetles to let themselves out from, which indicates that the eggs are laid inside the young acorns, the larval and pupal stages being passed inside the acorns in which the eggs are laid. The acorns are attacked on the trees and fall to the ground with the insect inside. The beetle is very lively, but feigns to be dead when disturbed. It is amusing to watch them coming out of an exit hole, often as many as six or seven coming out one after the other from the same acorn. The larva is white, short, and stunted, almost as broad in the centre as long, with a small pale brown head, and about $\frac{1}{8}$ " long. The pupa is white, of about the same length as the larva, and, as a rule, several are found together in the same acorn, often as many as six or seven. On removing the shell of the acorn the pupæ are exposed and are seen lying each in a separate compartment of its own. The kernel of the acorn is reduced to a fine powdery

*Weevil which attacks acorns of
Quercus incana - Mussoorie June 1902*



*Acorn with cap removed
Nat. Size*



*Acorn with shell removed
showing six cocoon cavities in
which pupae were found*

*for analysis
18/6/02*

condition, but is firm and fills the shell, so that when the shell is removed the inside appears solid with the pupæ lying in little compartments on its surface. With slight pressure, however, it falls to pieces, and it is seen that each compartment is really a small cradle-like cocoon covered above by the shell of the acorn. The beetle is of the regular weevil type, about $\frac{3}{16}$ " long, exclusive of the proboscis, the proboscis being slightly longer than $\frac{1}{16}$ ". On first changing from the pupal state it is a fine red colour, but this soon changes to a dark red-brown. The whole insect is covered with small punctures. The elytra do not quite cover the whole body, and have broadly rounded ends. They are ribbed, and the punctures are arranged in longitudinal rows, about fourteen rows on each elytron. They are about half the length of the body. The thorax is covered with punctures irregularly scattered. The proboscis is about $\frac{1}{16}$ " long and curved. The antennæ are elbowed and spring from near the base of the proboscis. The tibiæ of the legs are ribbed and bear a hooped spine, and the punctures are in longitudinal rows. Complete specimens are being sent to the Forest Entomologist for identification.

The insect is a very injurious one, and is largely responsible for the general absence of natural reproduction of *Quercus incana* from seed. The trees are now loaded with young acorns from last year's flowers, and it is quite probable that these will shortly be attacked, and there is every probability that another generation of the beetle will appear in the autumn.

DEHRA DUN :
8th July 1902.

B. O. COVENTRY,
Dy. Conservator of Forests.

The Effect of Forest Fires on Insect Pests.

IN a letter on fire-protection in teak forests in Lower Burma, which appeared in the August number of the *Indian Forester*, the writer says: "Fire probably does great service in keeping in check noxious insects, and fire-protection is probably partly the reason that *Hyblæa pueræ* and *Paliga damastesalis** are increasing so rapidly." Some insects may be destroyed by forest fires, but our own experience in Burma is that the visible insect life in a forest is much greater after the annual fires have taken place than before. Most insects adapt themselves to their surroundings, and manage to be in a place of safety during the season of fires. Thus the two species mentioned by our correspondent are said to hibernate underground at that time of year, and would, therefore, be quite unaffected by an adjoining jungle fire. If this were not the case, how would our correspondent account for the enormous number of "milaung-hmet" and other flies, and the swarms of cicadas among the In trees, which appear immediately after the

*The correct name of this insect is *Pyrausta machceralis*.

jungle fires? We have seen a good deal of teak defoliation by insects in Burma, and certainly cannot remember having noticed that the damage was greater in protected areas. In fact the former are so small in comparison with the latter and the amount of protection afforded so variable, that its effect on insect life so far cannot have been very great.

In this respect a fact worth recording has recently come under our notice in the immediate neighbourhood of Dehra Dun. Near here are some private sal coppice forests which are not protected from fire and which were burnt through at least twice during the past dry season, the last fire taking place immediately before the rains. Since the rains began these forests have been completely defoliated by a caterpillar belonging to the family of Noctuidæ, and at the time of writing—August 24th—the bare poles of the sal trees are still a conspicuous object in the landscape.

The Misuse of Coal.

Nature of March 20, containing a most interesting communication by Prof. John Perry on the "Misuse of Coal," has reached me lately. Surely Prof. Perry takes an insular view of the matter. Like so many Englishmen, alas, he knows not the forest. The greater portion of the world cooks its food and makes itself comfortable on wood fuel, and though all the forests of the world would, according to European ideas, be inadequate to supply by their growth the present expenditure of coal (their fossilised remains) to overlook altogether the sun power which we can fix by growing wood fuel, is surely, from even a European point of view, an oversight. Helmholtz compared the number of thermal units received by an acre of land in Germany during a year with the number of thermal units produced by burning the vegetable matter elaborated during a year. His calculation was that only the 1/1477th part of the sun's heat was thus rendered available.

On this basis it is possible roughly to calculate the maximum thermal efficiency as firewood of the wattle or Eucalyptus vegetation on the coast of Australia or South Africa. (Insulation is for the latitude somewhere about one-sixth greater at Cape Town than in mid-Germany; practically it is more on account of the clearer atmosphere.) The production of firewood is about five times as much; thus, taking Crottendorf as an example of a European forest giving one of the largest yields in timber, we have:—

Crottendorf spruce, mean yearly yield 153 cubic feet.

Quick growing Euclypts, South Africa, yield 700 cubic feet

or the maximum South African yield is five times the maximum European yield. But since the average weight of

euclypt wood is three times that of spruce, the heating power produced on an acre of euclypts must be set at about fifteen times that produced on an acre of northern and mid-European forest. Thus on the basis of Helmholtz's calculation, a euclypt plantation can, with the most favourable circumstances in South Africa or on tropical mountains, store up, say, $15/1500=1$ per cent. of the solar energy received on the unit of area.

The position in Cape Town to-day is that it is cheaper to plough the ground and plant a forest of quick-growing trees than to import coal from over the sea or by a long and expensive land journey. Firewood in Cape Town is worth nearly 1s. per cubic foot, and before the railway was extended to the diamond fields, firewood there has fetched 1d. per pound, the price at which sugar has been retailed in England.

No doubt from a British insular point of view, coal at £2 or £3 per ton is a terrible misfortune. It certainly increases the cost of running machinery; but if this does not take place to a prohibitive extent, and if it makes the user of power careful not to waste it, it is not an unmixed evil. And if thereby afforesting is made a paying operation, it is at least open to discussion whether dear coal and good forests would not be better for England than an expenditure of £23,000,000 sterling on imported timber, and the evils, including physical degeneration of the race and coal fogs in the big cities, which have been shown elsewhere to result from England's neglect of its forests. The reference to De Wet, in Prof. Perry's communication is unfortunate: a small quick-moving army would probably have caught him. And surely cheap coal and luxury is not the *summum bonum*. Rather let us have hamlets of strong forest workers than the luxurious town dwellers of to-day, with their decayed muscle and cheap mechanical power. Compare a European engine-driver with the runner castes of India and Japan. The engine-driver shows us perhaps fine inherited muscle, but going to decay for want of use; the Eastern runners show the developement of muscle by both use and inheritance. Which would have the best chance of catching De Wet a hundred years hence?

As far back as 1882 the discovery was made by Sir D. Brandis and myself that Eucalypts planted on tropical mountains will produce wood fuel at the rate of 20 tons (dry weight at 60lbs per cubic foot) per acre per year in perpetuity. The eucalypt plantation reproduces itself when cut, without further expense, and its dry timber, heavier than coal (which, as met with commercially, weighs 50lbs to 52lbs. the cubic foot) has an equal or a higher thermal power, bulk for bulk, than coal. We obtained this result as the maximum yield of *Eucalyptus globulus* on the Nilgiris, Southern India. No doubt there are other instances

where higher yields are produced now, and no doubt also when the coal supply is exhausted, selection and experiment will produce a forest vegetation that will produce more than 20 tons per acre per year. The sugar beet and all the fruits and vegetables of civilisation show how the Vegetable Kingdom can be moulded to suit man's wants. If a chance tree on a chance mountain in a chance soil can produce the equivalent of 20 tons of coal per acre per year, it seems not unreasonable to suppose that by selection we can produce, say, double this, or 40 tons. To produce this in perpetuity we should probably have to find a tree with the moderate soil requirements of the Conifers. A powerful sun, a heavy rainfall, and a very rapid force growth would be the essentials of such a production of wood fuel.

Looking at a rainfall map of the world, one sees that these conditions are fulfilled over about 8,000 million acres of its surface (which is about one-fourth and one-fifth of the total land surface of 35,200 million acres). I take latitudes below 40 degrees and rainfall above 40 inches. One-half of this area under forest might thus yield the equivalent of 161,000 million tons of coal yearly. This is more than 288 times the world's present consumption of coal, assuming that coal and eucalypt timber are of approximately equal heating power. On the basis of the actual forest yields of to-day we have half this, or 80,500 million tons. In Germany, one-fourth of the total area is under forest, and this is held on the highest authority to be the suitable proportion for a thickly-peopled civilised country such as Germany. The forest should properly occupy a higher proportion in countries where large areas are pestilential and unsuited for human habitation. Putting this, however, aside, and taking the German standard of one-fourth forest, then on the basis of to-day's maximum yields we should obtain a yearly output of 40,250 million tons. And if to convert the maximum forest yield to an average forest yield we again divide by two, we obtain 20,175 million tons.

Lower than this I do not think we can reasonably go for the class of forest under consideration. It is a little more than thirty times the world's present consumption of coal. The world's yearly output of coal recently was 663 million tons, says Prof. Perry.

Thus we see that the yield of firewood from the world's tropical and extra-tropical forests, whenever they are fully stocked and scientifically worked, will yield the equivalent of from 30 times to 122 times the present consumption of coal, or even up to 243 times the present consumption of coal if we succeed by cultivation in doubling present timber yield figures.

It may be objected that my figures are far in excess of those representing the yield of European forests, and that they require confirmation.

No doubt they are far in excess of European figures; but so also is the intensity of the vegetative process in these latitudes, and so also is the stature of the Sequoias of California, and the Eucalypts of Australia and South Africa above the stature of the biggest spruces and silver-firs of Europe. The Nilgiri figures I have quoted above were formally recorded in two official reports, printed and published by the Madras Government in 1882. They have since been confirmed by the measurements of forest officers, who have subsequently had charge of the Nilgiri plantations. Similar figures have been obtained by myself and other forest officers in South Africa. They have been exceeded in several plantations in Natal, while at Johannesburg they have not been confined to Eucalyptus, but have been obtained from *Acacia decurrens*, or black wattle, as well as from some other trees.

Therefore, "when our coal supply is exhausted, when all races of the world have fought for the waterfalls and places of high tide," there will still remain that which Englishmen of all the civilised races of the world do most neglect—the forest.

D. E. HUTCHINS, (in *Nature*).

Grootvadersbosch, Swellendam, Cape Colony, May 14.

1 "Suggestions regarding Forest Administration in the Madras Presidency," by D. Brandis, C.I.E., Inspector-General to the Government of India (Madras 1882).

"Report on Measurements of the Growth of Australian Trees on the Nilgiris," by D. E. Hutchins, Dep. Cons. Forests, Mysore (Government Press, Madras, 1883).

Rubber Cultivation in Selangor.

MR. STANLEY ARDEN, Superintendent, Experimental Plantations, Selangor, F. M. States, has submitted the following interesting report on the cultivation of the Para rubber tree and extraction of the latex, which we extract from the *Agricultural Bulletin* of the Straits and Federated Malay States:—

I have the honour to inform you that I visited S'tiawan (Perak) in June last, with the object of conducting some experiments on the production and coagulation of the latex of *Hevea brasiliensis*, which furnishes the "Para" rubber of commerce.

The trees utilised for these experiments were chiefly the property of the natives and had been neglected. The soil, which was dry and sandy and wanting in the necessary constituents of plant life, was in places densely covered with "lalang"—*Imperata cylindrica*, a vigorous grass which chokes out nearly all other vegetation. These conditions had evidently affected the growth

of the younger trees, for I have measured 3 to 4-year-old trees in other parts of the Native States whose circumference was equal to that of trees growing at S'tiawan which were twice the age.

The trees ranged from 7 to 10 years old. The approximate height of the 7-year-old trees was 40 to 45 ft., and the average girth 2 ft. 6 in. measured at 3 ft. from the base. The height of the 10-year-old trees was 55 to 60 ft., the circumference taken at a yard from the base ranging from 3 ft. 6 in. to 5 feet., the average being about 4 ft.

The trees had been planted irregularly, but it was noticed that some 9-year-old trees, planted 36 ft. apart, were touching each other at the tops. There is a tendency to plant trees much closer than this, and I mention this fact to show what amount of space this tree will occupy if allowed room to develop itself.

4. The incisions were made by means of a sharp pruning knife. An ordinary carpenter's chisel was also tried, but the knife found most favour with the Malays, who soon became used to the work. I prefer the knife to the chisel, as with it a cleaner cut is made, thus enabling the latex to get away freely—an important point, for if impeded in its flow, there is the possibility of its coagulating on the wound, thus preventing a further flow. Nor does there appear to be quite the same danger of cutting into the wood as with a chisel and mallet, and injuring the tree. I have recently had a knife made, fitted with adjustable blades, which will, I believe, when perfected, considerably reduce the cost of tapping.

With a view to ascertaining what part of the trunk contains the largest amount of latex, trees were tapped at different heights, ranging from the base of trunk to 6 ft. up. In almost every case it was found that the latex flowed most freely from the lower portion of the trunk. Ten trees were tapped on fourteen consecutive days with the following results:—

140 incisions from base to 3 ft. up gave 395½ oz. latex.

140 incisions 3 ft. to 6 ft. up gave 325½ oz. latex.

The greater exudation appears, however, to be chiefly confined to the first foot of the trunk, which must therefore not be neglected when tapping.

An attempt was made to determine the best kind of incision to make, and trees of the same age and dimensions were tapped with vertical, oblique, and double oblique (IVV) incisions.

Those tapped with the V-shaped incision generally gave the best return. If these incisions are made above one another and connected by means of a small channel, forming what is sometimes known as the "herringbone" incision, the collection of the

latex is simplified, but the return was found to be less favourable than when V-shaped incisions were made about 2 ft. apart and extending over the whole area. The two lines forming the V were in each case 6 in. long.

The different kinds of incisions, which on the first occasion were made about $\frac{1}{4}$ inch wide and just deep enough to cut through the inner layer of bark, were renewed at intervals. It is important that full advantage be taken of what is termed the "wound-effect," and this experiment was conducted, with a view to ascertaining:

(a) The number of times the incision might advantageously be renewed;

(b) The length of time that should elapse between each renewal.

The renewal is accomplished by taking off a very thin layer from each side of the wound, and was carried on for a full month at regular intervals, some trees being tapped every day, others every second, every fourth, and every seventh day; so that while some trees were tapped on thirty occasions, others were only tapped on four. The number of occasions it is advisable to renew the incisions was not decided, as in some cases the tree continued to exude latex even after having been tapped on thirty consecutive days. In a few cases the maximum yield was attained on the eighth day; while, in others, there was a gradual increase up till the fourteenth tapping. This difference in the behaviour of trees makes it impossible to lay down any hard and fast rule as to the number of times it is advisable to renew the incision, but in the majority of cases the maximum yield will probably be reached at the tenth or eleventh renewal.

Nor does it appear that there is anything to be gained by allowing the trees to rest a few days before renewing the incision, for the yield of those trees on which the incisions were renewed daily was equal to, and in some cases exceeded, that of trees which were tapped at weekly intervals. The ultimate result, therefore, would seem to be dependent, to some extent, upon the number of times the incisions are renewed, and it is doubtful if a saving of labour can be effected by renewing the incisions at long intervals.

Ordinary cigarette tins were used for the collection of the latex. These were attached to the tree by a small nail driven through a hole in the side of the tin, a little clay being placed between the tin and the tree to prevent any latex trickling down behind. I have had some similarly shaped tins made with a "lip" which is filed at the edges. The lip is simply pressed into the bark, no nail being required, while any escape of latex is impossible. A loose lid prevents any dirt or pieces of bark

from falling into the latex. The latex exudes very slowly, and it was generally found necessary to leave the tin on the tree for about an hour after making the incision.

Several methods of preparing commercial "india-rubber" from the latex were tried, and coagulation by the addition of mercuric chloride, sodium chloride, alum, acetic acid and other reagents was effected, but as these are still under consideration, I do not intend to dwell upon them here. I am satisfied, however, that a good marketable rubber can be obtained, at a very small cost to the producer, in three or four days, if he has suitable drying accommodation at his command.

The difference in yield of trees of the same age and growing under similar conditions is very remarkable, making experimental work difficult, especially when the number of trees at our command are limited. The amount of dry rubber obtained from 9-year-old trees varied from 7 to 81½ oz.* The average yield per tree was just under 2lbs.; but, had all the trees been tapped on the most approved style and the incisions renewed an equal number of times, this amount would doubtless have been exceeded.

The youngest trees tapped were 6 to 7 years old, and gave an average return of 12½ oz. of dry rubber. This was the result of fourteen days' tapping, i.e., the incisions were renewed on fourteen consecutive days, so that the average yield per day was less than 1 oz. of dry rubber. These trees had been much neglected, and I think it is fairly safe to prophesy a return equal to this from European estates, where the trees receive every attention in from five to six years from the time of planting.—*Indian Gardening and Planting.*

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The Insect World in an Indian Forest and how to study it.

PART I.

(Continued from page 330.)

SOME CHARACTERISTIC FEATURES OF INSECT LIFE.

It will be interesting to first glance briefly at some of the characteristic features of insect life in general. Insects form by far the largest part of the animals of the world; they outnumber in species all the other terrestrial animals together; whilst compared with the vertebrates their numbers are simply enormous. It is perhaps owing to their size that they have been so little studied as a Class and that so little is known as to the number of species at the present moment living upon the earth's surface and of the habits of the greater number of the known species. The largest Insects scarcely exceed in bulk a mouse amongst mammals or a wren amongst birds, while the smallest are almost or quite imperceptible to the naked eye, and yet the larger part of the Animal matter existing on the lands of the globe is probably contained in the forms of Insects.

In the waters of the globe the predominance of Insect life disappears. They practically only exist in any numbers in small collections of fresh water, and then it may be for only a portion of their existence; of the larger bodies of fresh water they invade the fringes only, and they are almost absent from the oceans.

Insects may be said to be the most successful of all animals in the struggle for existence, and this is probably due to the rapidity of their growth owing to the peculiar relations which exist between the great functions of circulation and respiration, these being of such a nature as to enable the nutrition of the organs of the body to be carried on rapidly and efficiently so long as a certain bulk is not exceeded.

Rapidity of growth is in the case of some Insects very great and the powers of multiplication even greater still. In addition by a process known as "metamorphosis," growth and development

can be isolated from one another, thus allowing the former to go on unchecked and uncomplicated by the latter. It was probably in allusion to some of these favourable features of Insect life and the remarkable rate at which they sometimes multiply that Linnæus made the statement.

Tres muscæ consumunt cadaver equi, æque cito ac leo, or "that three flies would consume the carcase of a horse as quickly as a lion."

It has been calculated that one female of the common house fly *Musca domestica* may have 25,000,000 descendants during one season.

I have said that growth and development can be isolated from one another, and thus we get the different stages in the life of an Insect, known as the egg stage, the larval or grub stage, the pupal or resting stage, and the final or imago stage. When all these four stages are present the metamorphosis is said to be 'complete.' During the second of these the insect often eats voraciously and increases rapidly in bulk, development taking place at a later stage. The pupal stage is absent in some Orders of insects and the metamorphosis is then said to be 'incomplete.'

As is well known, some kinds of Insects form organised societies and live together in communities—a method of existence displayed by few other animals save man. We shall have occasion later to allude to some of the Insects living in this fashion when we consider the *Termitidæ* (the so-called white-ants), and the *Hymenoptera Aculeata* (the bees, wasps, and ants). It will be unnecessary here to dilate upon the beauty of Insects. The beauty of the butterfly is proverbial, and those who seek will find it reproduced again and again in numberless minute forms of the Insect World which perhaps compose the greater bulk of the Insect Life in the Indian forest—a world teeming with some of the most beautiful and certainly not the least interesting of created beings, and yet at present as little known as was America before the days of Columbus.

To commence the study of this life will not require hours of unproductive and wearisome search. The leaves of the nearest tree will be found to contain their quota of defoliators, be they the caterpillars of butterflies or moths (*Lepidoptera*), or the grubs of beetles belonging to the *Chrysomelidæ*, *Curculionidæ* (weevils), &c.; leaves and twigs will be found yielding up their sap to numbers of aphids or plant lice (*Aphidæ*) and scale insects (*Coccidæ*, &c.; their seeds will be riddled by the grubs of *Hymenoptera*, *Diptera* and weevils. If intent on our study and with the wish to arrive at some definite reason for the death or sickness of trees, we carefully examine the bark, it may be found riddled with pin holes. On stripping it off we shall drop into a perfectly new world of life below, a world which spends its existence beneath the bark of trees and leaves its shelter in many instances but for a nuptial flight. Here we shall find a veritable Tower of Babel of Insect Life, consist-

ing of genera of many different families the individuals of which are present with very different objects. The particular families and genera present will depend greatly upon the condition of the tree we are examining. If still green but sickly and dying, or newly felled, various bark borers will be at work laying eggs in the bast layer, the larvæ of which on developing will feed on the still fresh bark: *Buprestidæ*, *Curculionidæ*, *Cerambycidæ*, *Scotyidæ*, and various families of the wood boring *Heterocera* (moths) may be present. Other genera, some perhaps very minute, will be feeding upon the oozing sap. Others again on the dying and drying bark; whilst numerous predaceous Insects belonging to one or more of the great Orders, such as the *Orthoptera*, *Hymenoptera*, *Coleoptera*, *Diptera* and *Hemiptera*, will be found, exhibiting an enormous variety of shapes and peculiarities both in their larval, pupal and imago stages. Where all is new it is invidious to particularize, but there will be little doubt in the minds of those who take up this study that the work of a lifetime would not suffice to become acquainted with the life-histories of one tithe of the predaceous Insects which spend their existence beneath the bark of our Indian trees, nor even to study them so far as to be able to say that such and such a larva becomes such and such a pupa and imago. The surprises in store for him who endeavours to grapple with this aspect of the work alone will perhaps do more than anything else to show him how little is at present known in India on the subject of the life-histories and developments of some of her commonest Insects, and how urgently recruits in this department of knowledge are required. Instances could be enumerated of insects which, if sought for in their abodes beneath the bark or in the roots, in the twigs or on the leaves, &c., are to be found almost as plentifully as the common house fly and throughout the same period in the year, and yet neither their eggs, larvæ or pupæ are yet known.

Leaving the bark and cambium layer of the older trees, we will now turn to young saplings and the smaller branches of the older trees. A search in this direction may show that grubs have gone into the interior of the stems and are boring their way up or down the centre. This will probably be the work of longicorn beetles or of the wood-boring moth larvæ. In the wood of older dead trees round shot holes or large oval galleries may be found riddling it through and through, the work of the wood boring families of Insects, the wood wasps (*Sirex*) and boring beetles and their larvæ or boring moth caterpillars. Our search need not terminate here, however. There still remain the roots of the tree, and to get at these it will be necessary to excavate the earth all round so as to leave them exposed in a pit where they can be examined satisfactorily. Here again we shall find many members of the Insect World. Aphids sucking out the sap, the very life of the young tree, bark borers, wood-borers, and their attendant predaceous and parasite compan-

ions, sap feeding beetles and dead bark eaters—some or all may be present, the individuals being probably of entirely different genera and species, if not families, to those working higher up in the trunk, main branches, twigs, or on the leaves and in the fruit and seeds of the tree. The above rough notes will show that it is not difficult to find some of the homes of the Insect Life in an Indian Forest. The study of it will require careful observation, and whilst training the eye to observe, will develop the faculty of reasoning and working out results as well as and, one would think as usefully as, the most abstruse problem in mathematics.

Note.—Before proceeding to a consideration of the Orders it may be of use to mention shortly here the different parts of an Insect. I have said it may have four stages, the egg, larva or grub, pupa or chrysalis, and the imago or perfect insect. A mature Insect consists of three main divisions, the head, the thorax, and the abdomen. The head bears the mouth parts consisting either of a biting mouth or a sucking mouth. The biting mouth consists of an upper and lower lip—the labrum and labium, the mandibles (the biting jaws) and the maxillæ (the chewing jaws) with the palps, which are short jointed appendages which may be four in number. In the sucking mouth a long tube or proboscis is present, by adaptation of some of the above portions. Occasionally the mouth is both biting and sucking. The head also bears the eyes, which may be compound, composed of a large number of facets, or simple (ocelli), and the antennæ, consisting of a number of joints. The thorax, which comes behind the head, is divided into three portions—the prothorax, bearing the first pair of legs, the meso-thorax, bearing the second pair of legs and the first pair of wings (if present), and the meta-thorax bearing the third pair of legs and the second pair of wings (if present). Behind the thorax comes the abdomen, consisting of eleven segments, which are usually freely movable upon one another and never carry locomotive limbs. The extremity of the abdomen is, however, often furnished with appendages which are primarily connected with reproduction, but which are often converted into weapons of offence and defence. Of such a nature are the ovipositors of Ichneumonids, the stings of bees, wasps, &c. The leg is divided into several joints—the coxa, the joint of attachment to the body, the trochanter, a short joint following the coxa, the femur (or thigh), the tibia (or shank), and the tarsus, composed of a number of joints, from one to five in number; following the tarsus there may be a claw.

PART II.

THE ORDER ORTHOPTERA.

The ORTHOPTERA are Insects with mouth parts conspicuous, formed for biting; the four palpi (the small 'feelers' on either side of the mouth) very distinct, and the lower lip longitudinally divided in the middle. The upper wings (*tegmina*) are of parchment-like consistency, being closed in repose on the back of the insect so as to protect it. The lower wings are of more delicate consistency, large and furnished longitudinally with fan-like nervures (veins) and small cross ones which form together a network in the wing; they are generally covered over by the upper wings. The mode of growth of each individual is a gradual increase in size, the wings being developed during the last month, i.e., the metamorphosis is incomplete, as there is no pupal stage. Species exist in which the wings are absent or rudimentary.

The *ORTHOPTERA* are Insects of comparatively large size, the order containing some of the largest known *Insecta*. It includes earwigs, cockroaches, praying insects or soothsayers, stick and leaf insects, grasshoppers, locusts and crickets.

The members of the Order often spend some time in the egg stage. The wings are never present when the Insect is first hatched, but appear subsequently and increase in size at the moults; the form and proportion of the segments of the body, especially of the thorax undergo much change; changes in colour occur at the moults, and the integument becomes harder in the adult condition. The wings in many are absent, and flight appears to be of minor importance in the Order; in many cases where the wings exist, they are purely musical organs and are not of any use for flight. The upper wings are never used for flight. The musical powers of the *Orthoptera* are confined to the *Saltatoria* group. The *Cursoria* are dumb or nearly so; in this latter series the wings have little value for flight, and are simply used for purposes of adornment or concealment, and more especially so in the *Phasmidæ* and *Mantidæ* (praying insects and stick insects). Here the upper wings frequently exhibit a great resemblance to vegetable structures, such as stems, leaves, &c., the veins and shape of the leaf being copied with remarkable accuracy in the wing of the Insect. Contrary to the usual conditions amongst Insects, the ♀ is often more remarkable in colouring than the ♂.

The eggs of the *ORTHOPTERA* are deposited in capsules or cases; these capsules may contain only one egg or a great many.

The number of existing species of the Order is estimated at 10,000, but this is probably far under the mark, as the small tropical forms have never been properly collected.

We shall treat the Order as comprising seven families:--

Series *Cursoria*.
Hind legs but little
different from the
others.

Series *Saltatoria*.
Hind legs elongate,
formed for leaping;
their femora usual-
ly thickened.

1. *Forficulidæ* (earwigs): upper wings short, lower wings complexly folded; body armed at the extremity with a strong forceps.
2. *Blattidæ* (cockroaches): coxæ of the legs large, exerted, protecting the lower part of the body.
3. *Mantidæ* (praying-insects): front legs very large, raptorial, armed with spines.
4. *Phasmidæ* (stick-insects): meso-thorax large as compared with the prothorax.
5. *Acrydiidæ* (locusts): antennæ short not setaceous, of not more than 20 joints; tarsi three-jointed.
6. *Locustidæ* (grasshopper): antennæ long, setaceous, composed of a large number of joints: tarsi four-jointed.
7. *Gryllidæ* (crickets): antennæ very long, setaceous; tarsi two- or three-jointed.

FAMILY *Forficulidæ* (EARWIGS.)

These Insects are distinguished by having a horizontal head and very short wing covers, *i.e.*, upper wings, which do not extend beyond the insertion of the hind legs and repose flat on the back, meeting together in a straight line along the middle. The lower wings are folded beneath the upper, projecting at the lower end in small slips from beneath them. This formation of the wings is characteristic of the family when wings are present. The end of the body is furnished with a pair of large callipers.

This family is not of great importance as far as is at present known to the forester as regards damage done by it in the forest. It may, however, prove of some service in preying upon noxious pests. Whilst visiting the sandalwood areas of North Coimbatore in Madras, I noticed that a large grey earwig was almost invariably present in the old galleries of a longicorn beetle, which bores into the stems of saplings and tunnels down their centres. These tunnels were also used as a home by a species—probably new—of white-ant, which was tunnelling through the wood of still living trees. The earwig was, I think, predaceous upon the ants and their larvæ.

FAMILY *Blattidæ* (COCKROACHES).

These are one of the oldest forms of insects known, for it is certain that in the carboniferous epoch they existed in considerable numbers and variety, and the remains found do not differ very essentially in appearance from present-day forms. The group contains about 800 species, divided into ten genera.

The head is bent vertically downwards, so that the mouth is on the under part. Antennæ are very long and flexible, bristle-like, and consisting of 75—90 joints, longer in the male than in the female. Their function is supposed to be that of smelling. The body is very flat, ending in small flat processes, the cerci which are usually distinctly jointed. Long strong running legs, with large femurs are present.

These insects are common in houses, vessels employed in river and ocean traffic, &c. Their larvæ, much resembling the adults, but without wings, are often to be found in rotten stumps of trees in the forest. As a family their food is of a very mixed nature.

FAMILY *Mantidæ* (PRAYING-INSECTS).

The *Mantidæ* are allied to the cockroaches, but differ in various respects. The body is, on the whole, more elongate, the prothorax being very long. The first pair of legs are prehensile, with large coxæ, strong femurs (thighs) with two rows of spines and tibiae (shanks) also furnished with two rows of spines, which can be folded back upon the femurs; with these appendages the animal siezes its prey, which consists of other insects. The ova are attached to plants in groups, surrounded by a capsule. The eggs last deposited are said to hatch first.

Many of the Insects of this family mimic to a certain extent the objects amongst which they live. A mantis of Eastern Bengal called *Gongylus gongyloides* has its under surface resembling the pink corolla of a papilionaceous flower. It usually hangs head downwards amongst green foliage simulating a flower, and insects flying to and settling upon it are seized and consumed. This insect has been known to science for upwards of three centuries, and yet very little is known about the various stages of its life history, a case well illustrating the remarks already made upon this subject.

The *Mantidæ* are not of forest importance, although they are common enough, and are often attracted to the lighted bungalow at night and may be watched stalking their prey or waiting motionless on the dining table or on the white-washed walls.

FAMILY *Phasmidæ* (STICK AND LEAF INSECTS.)

The *Phasmidæ* are inhabitants of warm countries. They mimic dry sticks and leaves in a marvellous manner. The wings are rudimentary and legs very long. The prothorax is very short and the meso- and meta-thorax unusually long. Their eggs have a remarkable resemblance to seeds of plants. They are dropped singly by the insect at random on the ground, being enclosed in a capsule.

The genus *Bacillus* is wingless, the elongate body and long legs looking like a dry branched twig or piece of stick. This genus feeds upon foliage, at times doing very considerable defoliation in Australia. They are, however, very sensitive to cold, and frost will always put an end to them there. In Fiji and the Friendly Islands a species of *Lopaphus* eats the leaves of the cocoanut, and at times causes such a scarcity of food that it becomes necessary to take measures to destroy them.

The genus *Phyllium* occurs in the tropical regions of the Old World. A species of *Phyllium* is the Indian leaf-insect, whose broad abdomen and upper wings are exactly like a leaf and the legs are flattened out and also resemble portions of leaves. Natives of India believe, and have given me the information as solemn truth, that the Insect is only a leaf, which developed as such originally and then *took to walking*.

FAMILY *Acridiidae* (LOCUSTS.)

The hind legs differ from the others in being more elongate and in having their femora broader near the base. Antennæ short and thick, with less than 30 joints. There is no exserted ovipositor in the female. Tarsi are short with three distinct joints. The auditory organ is placed on the upper part of the side of the first abdominal segment. The large head is joined to the thorax in one piece, the front being deflexed downwards at a sharp angle. Besides the two compound eyes there are three

ocelli (small simple eyes) present. The upper wings are roof shaped.

This family is remarkable owing to the presence of air sacs in the interior of the Insect in connection with the tracheæ, and it is doubtless the possession of these that enables them to undertake the great flights they perform when migrating.

The chirping sound of locusts is produced by rubbing together the outer face of the upper wing, one of the veins in which is prominent and possesses a sharp edge, and the inner face of the hind femur, which bears a series of small bead-like prominences placed on the upper of the two lower ridges that run along the side that is nearest to the body.

The *Acridiidae* include the grasshoppers of the fields and the important migratory locusts of this country and other parts of the world. The Family contain more species and individuals than any other Orthopterous family, and is a most important one, as all its members feed upon growing plants. It includes what are perhaps two of the most dangerous insect pests in the world — the great North-West Locust (*Acridium peregrinum* of India) and the migratory locusts of North America, insects which at times swarm in millions and clear the country they invade of every green thing. Every leaf is stripped from the trees and every blade of grass consumed and fields of crops eaten down as the flight moves onwards, leaving devastation and ruin in its wake. There are many species of *Acridiidae* in India, and many of them at different periods swarm and do damage. We will consider shortly the life history of *Acridium peregrinum*.

The home of this locust is in the sandy deserts of Rajputana and Sind, from which it periodically invades the whole of India. The eggs are laid in the ground and hatch out in about a month, but two months or a much longer period may be spent in the egg stage if conditions are not favourable to the young ones hatching out. The young are little blackish wingless grasshoppers, which feed upon green plants of all kinds. At the end of the first five days after hatching the young 'hoppers' pack together and march in serried columns into the fields and begin their work of devastation. This stage lasts from one to two months, during which time the insects moult their skins at intervals. Their wings develop during these several moults, and the last shedding of the skin leaves the Insect with perfectly developed alar appendages. As soon as they are fully mature, the locusts, leaving the areas from which they have already eaten everything green on the surface, take wing and fly to fresh districts, which they proceed to devastate in a similar manner. After a week or two spent in these wanderings the insects pair and the females commence egg-laying in the soft soil of the cultivated lands.

When the insect first acquires wings it is salmon pink in colour, but later it changes to yellow and then to a dull purple.

The invasions of this insect are periodical, the average number of years that elapses between invasions being about eleven, but a longer interval may elapse. The last great attack occurred between the years 1899-1893, whilst in 1901 the insect spread as far south as Ganjam in Madras and east to the Bramaputra River. Whilst these great flights are present in a district green foliage of every every description suffers severely and the bark is peeled off young saplings. Nurseries and young plantations thus suffer severely from these insects during great invasions, whilst the soft earth of the beds is used by the females for egg-laying, the eggs being laid by her in a hole in the soil which she digs with the ovipositor (the blade-like instrument) at the end of her body. If these eggs are not, either dug up and collected or ploughed in so as to destroy them, the young hoppers will on hatching out do further injury to the young plants. When fully developed swarms of locusts are seen near or in the forest, every efforts should be made to mark down the places at which they alight. If after they have left the surface of the soil is seen to be covered with small holes, like holes made in soft earth by rain-drops, eggs have been laid on that area, and these should be got rid of before they hatch out, or the young hoppers should be killed off as soon after hatching as possible and *before* they pack into columns.

In addition to the migratory locust proper, most of the provinces of India have one or two large local locusts, which particularly affect their own part of the country and produce the local swarms which on occasions do so much damage.

Acridium succinctum is the locust of the Bombay Presidency, and breeds in the Ghats. It is also to be found in Western Bengal, and probably breeds in the Chota Nagpur hills. In the Nilgiri range of hills in Madras *Acridium ceruginosum*, *Acridium melanocorne* and *Tryxalis nasuta* have their home and are the locusts which at times swarm over the Presidency from that centre. Two species *Tryxalis nasuta*,* and *Oxya velox* have been reported as attacking and injuring young chir (*Pinus longifolia*) and robinia seedlings in the Kangra Valley, Punjab.

Locusts are preyed upon by two dipterous parasites (both on *A. peregrinum*,) one of which attacks the egg, the other the mature insect. In addition a Carabid beetle (*Calosoma orientale*, Hope) and the rosy pastor starling (*Pastor roseus*) cause great havoc amongst the flights. A large amount of investigation work remains to be done amongst the smaller members of the family in India, as it is not improbable that they are capable of developing into serious plagues when favourable conditions, such as a dry season and the adjuxtaposition of large masses of their favourite food plant.

* See Departmental Notes on Insects that affect Forestry, No.1. pp. 1-5.

FAMILY *Locustidae** (GRASSHOPPERS).

These insects are generally known as the long-horned grasshoppers, from the fact of their having very long bristle-like antennæ. They are usually grass-green or brown in colour, and their bodies are flattened and more lightly built than the true locusts. The eyes are round, the legs slender, and tarsi four-jointed. Wings are roof shaped. On the tibiæ of each of the front legs there are two auditory organs, and the males make sounds by rubbing the basal portion of one upper wing, the under side of which has a transversely ridged edge, over a corresponding portion of the other. The female possesses a long sabre-like exerted ovipositor. The eggs are laid on the ground or on leaves, stems, &c.

This family is of less importance than the true locusts. It contains the insect known as *Schizodactylus monstruosus*, Brullé, a grasshopper which can be at once recognised owing to the fact that the ends of its wings are curled up in a coil at the end of its body. It is known as 'bherwa' in the indigo districts, where it does a large amount of damage by cutting off indigo, tobacco, and other crop plants with its enormous shear-like jaws. It is also plentiful in Assam, and I believe I am correct in stating that it is to be found in the Madras Presidency. A pest of this kind can commit an incalculable amount of harm in nurseries of young plants.

FAMILY *Gryllidae* (CRICKETS).

The *Gryllidae* are closely connected with the *Locustidae*. The antennæ are long and slender and setaceous; hind legs long and used for jumping purposes. The upper wings have the outside portion bent down on to the side of the body, whilst the inner portion lies horizontally on the dorsal surface. The tarsi are usually three-jointed. The female has a long ovipositor. Wingless forms are numerous. The musical and auditory organs are situated in the same position as in *Locustidae*. The *Gryllidae* differ from these latter in the 3-jointed tarsi and position of upper wings in repose. The body is thick and cylindrical, and the eggs are glued together and laid in holes in the ground.

This family contains some injurious pests, of which two more especially harmful will be mentioned. The mole cricket (*Gryllotalpa vulgaris*) is a large insect, which has the front legs thickened for digging purposes, and has the prothorax enormously enlarged, resembling the carapace of a lobster, and there is no ovipositor present. The forelegs have a very short and thick femur and tibia and the tibia is prolonged into a series of four points and is concave on the outside. The first two joints of the tarsus are prolonged into teeth. The fore wings are very short and oval and the hind wings are rolled up upon themselves like a rolled-up umbrella and extend back in two points. This insect is

* It will be noted that the *Locustidae* are not locusts but grasshoppers, the true 'locusts' belonging to the *Aceridiidae*—an unfortunate nomenclature which it would be impossible now to change.

dangerous, as it burrows underground in grass lands, gardens, and nurseries, destroying the roots of plants in its operations.

The second injurious species which has proved itself a pest in India is a cricket named *Brachytrupes achælinus*, which has a very wide distribution. The life history of this insect has been partially worked out by the writer and an Assistant in Eastern Bengal (Chittagong Hill Tracts). Larvæ about half grown were found in April voraciously feeding upon young rubber (*Ficus elastica*) seedlings in nursery beds, into which the young plants had been transplanted from the pots in which they had been raised from seed. It was not until some 40 per cent of the seedlings had been killed off that the aggressor was marked down in the holes in which it lives. These holes are about an inch in depth and circular, projecting down into the earth at an angle. The insect feeds chiefly at night, spending the day in its hole, into which it drags some of its food plant to consume during the day. Soft soil is chosen to dig the holes in—and therefore the nursery beds are preferred, but any soft spots in the neighbourhood will be found to contain numbers of the insects. The young larvæ feed till the beginning of the rains, about the middle of June. They then cease until October, and they would appear to rest during the heaviest of the rains, though there is no pupal stage proper in this Order. In October the damage in the nursery recommences, and the holes will be found to contain two fully developed insects, male and female, at the bottom of each, the holes being now some 2"—2½" deep and winding. The Insects at this period feed voraciously, and continue to do so for a month. In November they die off, the female probably first laying her egg in soft patches of soil in the ground. All such areas should be carefully and deeply ploughed or hoed up so as to kill off the eggs by exposing them at the surface. When an attack has been discovered in progress, small boys should at once be put on to dig up each hole and kill the insect at the bottom. This will be found to be a cheap and effectual method of getting rid of the pest, which, if left alone, will do an immense amount of injury. Being a large-bodied insect, some 2½ inches long, it is capable of consuming during its life a considerable amount of green food material.

USEFUL ORTHOPTERA.

The number of Orthoptera known to be of use to the Forester is a small one. The *Mantidæ* may be said to be useful to a certain extent, in that they destroy insects of all kinds, and in their larval stages in some cases they probably feed largely upon *Aphidæ*. As I have mentioned in my notes under that family, the *Forficulidæ*, in spite of the bad reputation they have amongst gardeners as being injurious to vegetation, are much more likely to be of use, since many are undoubtedly predaceous upon larvæ, small snails, &c., which live upon plants.

* See Departmental Notes on Insects that affect Forestry, No. 1, p. 6.

V.-SHIKAR AND TRAVEL.

A Tiger Story

It is not often we foresters, at any rate in this part of the world, have a chance of meeting each other in camp. It had, however, been discovered that the Presidency had not made so many working plans as other more advanced (?) Administrations, and working plans officers had been appointed. This gave me the hitherto unheard of treat after many years' service of doing six weeks tour with a fellow man and he a fellow-forester, to wit, X. X had never, like many another keen man, even seen a tiger outside a cage, so I was anxious to at least show him one, as our route lay right through a famous (to very local sportsmen) tiger country.

I should mention that our Conservator—a non-shikari—was with us, and as his time was limited to three weeks, we had to be continually on the move and could do no justice to some of the opportunities going while he was with us. For instance, there was a tiger at our first camp, but we could not wait, and while our bait-bulls tied behind a baggage cart were doing a night march to the next camp, they were attacked by a tiger, which killed one and mortally wounded the other. There was no time to do more than erect a hurried machan, as we only heard of the occurrence at the next camp, having taken a different route to the cart, when the rain came down in torrents, the fag end of the north-east monsoon, and we got three hours' soaking and no tiger. A stiff peg with very little soda, followed by a four hours' march along a slushy dark jungle track, with only the lightning to help us to see,

followed by more whisky and hot baths, successfully kept us free from fever. Tigers at the next two camps, but no time to stop for shikar, and at the furthest camp a man-eater had taken off a boy shortly before our arrival. We tracked for half a mile and found that he had swam to an island in a flooded river *with the boy* and there was no means of following.

Our Conservator eventually left us, and buried his head boy, who had died of fever, the day after leaving us. I may mention that five subordinates and servants died on this tour, so let not any enquire of this country, for its climate is of the deadliest even if there are a few tigers. Just after he left came our chance. In a village enclosure in the reserved forest which we had visited a month before, the patel had some time previously shot a fine tiger, but was ordered not to do so again without ascertaining whether any forest sahib was within fifty miles. He was a reasonable sort of patel, who, although a plucky shikari, could quite see that seventy rupees without risk was as good as that amount with the chance of being mauled, so when a village bull was killed in the afternoon and he found that we were encamped five miles off, he at once sent us word. I always take with me into camp where there is any chance of any shikar a sort of wooden frame which can be made with short lengths of bamboos into a screen with four sides; the whole thing can be fixed up with leafy branches and carried anywhere. It is sufficiently strong to resist the first shock of a tiger if he sprang on it, but would not do to keep one out if he meant to get in. Where the forests are so vast as they are here and one has no companion, beats, except under very exceptional circumstances, are impracticable. It might be all right if the local tribes knew anything about the art of beating, but they don't. Indian file or all in groups is the method they prefer if there is anything more than a cheetal about. The advantage of this screen is that there is no noise to be made at the kill: four men carry it and place it in position and return, leaving one inside. It was most fortunate that we had such a contrivance, as the whole of the jungle round the kill in the village enclosure had been coppiced by shifting cultivation, so there was no sort of place to put a machan. The kill was on the top of a little hillock at the side of a hill densely covered with growth, and the whole country for miles in all directions was forest. After inspecting the remains of the bull we went to the village and rigged up the screen, and after breakfast went out and made ourselves comfortable with rugs &c. by one o'clock and just four yards from the half-eaten bull (the wind being favourable). X had a book, but wishing to get the earliest possible intimation of the arrival of our expected visitor, I was much on the *qui vive*, and managed to hear at about 5 P. M. what I thought was the tiger cleaning its claws on the bark of a tree, whereupon I suggested to X that he should put away his book so as to be quite ready. I was very possibly

right in my surmise, for very shortly afterwards, straight in front, about 10 yards off, with the usual absence of noise, appeared the tigress. We could not see her well as there was so much coppice growth; so little could X see of her that he thought it was a jungle dog. "Dog," he whispered, "no tiger." She stopped for some time swaying about her head to see if the kill was all right. It seemed a long time, and we both rather hankered after firing lest she might go off. At last she made up her mind that it was all right, and with a snarl of delight she came into the open. It was arranged that X was to have first shot, and he asked, "Shall I fire?" as the tigress was coming straight towards us. As I did not want him to risk a frontal shot with a hollow .450 bullet, I told him to wait. The tigress came on—a most beautiful sight—and we could then understand why natives who have seen them give one *such an exaggerated account of the size of their head*. She appeared to be *all head* at four yards, and her eyes seemed immense with a phosphorescent glaze. I had covered her right eye with my .577 and X was aiming between her eyes. In the excitement of the moment my rifle went off a fraction of a second before X's, at which I was most disgusted, but it was one of those things that we cannot help or explain. Needless to say that I insisted, in spite of X's protest, on its not counting. Well, before the smoke cleared she was pounding down the side of the hillock, and without exaggeration we would have thought that nothing but an elephant could have made such thuds on the ground. It was then dusk, and having received a .577 and .450 bullet at four yards in the face, we thought that we should find her dead the next morning and decided to leave her until then.

The next morning we started to find her, and for our purposes one could not have had worse jungle, but for the tigress it was all that she could wish. We did not find her dead at the foot of the hillock, as we expected, but there was plenty of blood on the coppice growth. We proceeded very gingerly and carefully, expecting to find her at any time. After half a mile of very slow work we found her tracks along a dry stream bed, and on following these we came across every now and then pieces of half digested flesh, so we knew that she was badly wounded.

As the stream bed narrowed, things became more exciting, until at last it got so narrow that the surrounding growth closed above it. Here we found the tigress; she got up with a growl, but did not charge, and owing to the dense growth got off before we could get in a shot. As we were discussing what to do, the tigress walked across the stream bed we had come along twenty yards behind us. X put up his rifle to fire, but unfortunately had some most inferior cartridges and his rifle missed fire. This was so unexpected that the tigress again entered the thick jungle without being shot at. As there was the boundary of the village enclosure a little way off, and as the tigress had not crossed it, we

thought that we should be sure to get her as she crossed, and immediately proceeded there, while the beaters beat from where we saw her cross the stream bed to the line. It was most curious, but we beat every inch of the locality many times, but the growth was so dense that we could not get her out, and had to go to breakfast without knowing where she had gone. In the immediate vicinity was a broad stream with a foot of water in it, and we beat in that and many other directions in the afternoon and had to give it up.

The next morning we brought out the village buffaloes, and drove them through the thickest parts of the jungle, where we thought she might be, but although we found the place where she had slept within a few yards of where she crossed the little dry stream bed and where we had beaten, we could not find her. We began to look somewhat blue, as we thought that she would go and die in some place where we would not find her, for we were sure that a beast that would not charge or run away must be in a bad way and could not survive long. We therefore sent for the villagers from far and wide for a beat on as extensive a scale as we could manage. The villagers, however, fought, shy of coming, but the patel of a neighbouring village some three miles off came and told us that for two miles along the path by which he had come there were fresh pug marks. This gave us new hope. We followed the marks, and when we found where the maker of them had rested by the aforesaid water stream, we felt sure that we were on the right track and that we should come across her before long. We had to track a mile further before we came across another dry stream bed where here pug marks were quite fresh. This was followed to its junction with a water stream, where the tigress had just drunk, the drops of water from her mouth being on the pebbles near the water. On seeing this every native, except a trusted forest guard with my second rifle, was up a tree. The tigress had gone up a dry nullah, and as this narrowed with steep sides, things again got somewhat exciting. She had left the nullah, however, and we lost the tracks for a little, but found them again leading down to the water stream, which she had crossed, and entered a little nullah all covered with growth. X, who did not mind his boots, proceeded into the water to the nullah entrance, while I preferred to be carried across to preserve my sambar boots. Scarcely had I been deposited upon the ground across the stream when X said, "Here she is," and fired point blank at her face and missed. Again she would not (most fortunately) charge, but slunk out behind. She now got to a little rocky hillock, and as she might be waiting for us behind any rock, it was suggested that we should execute a flank manoeuvre and try to cut her off. We tried the hillock sideways, but when we got to the top we could discern nothing of her, and it was suggested that the only thing to do was to return and come straight up the hillock. X said, "Let us look over this

side," and before we had gone five yards he said, "Here she is," and fired at three yards only. The shot knocked her over, but his next missed fire again: so I had to take up the running as his shot in the back had not killed her; here she finally succumbed. We were most curious to see the effects of our first face shots which had taken all the wish to charge out of her, although her legs were uninjured. All that was visible was a slight cut between the eyes which was X's hollow .450 express rifle bullet and a little wound half an inch above the centre of the nose which was the .577 expanding bullet. The latter had gone through the palate and into the throat, where it had made a ghastly wound into which one could put ones fist, but no part of it came through the skin. Poor beast, she must have suffered very much, and we were glad to have been able to put her out of pain. What impressed us especially was the little damage, for it was nil, of a hollow .450 express bullet almost straight between the eyes, and the very great chances—almost complete—of the wounded tiger when followed up being able to score first in such a jungle, except in a particular case like the one in question, where it was too cowed to attempt to do so.

Toots.

VI.—EXTRACTS, NOTES AND QUERIES.

Forest and Police Entrance Examination.

The following have been declared by the Civil Service Commissioners to have obtained the first nineteen places in order of merit in the competitive examination held on 15th July and following days for nineteen appointments in the Indian Police Force:—

	Marks.		Marks.
M. H. Eyre	... 9,194	H. E. Williams	... 7,774
S. T. Hollins	... 9,094	S. F. Ellis	... 7,750
B. B. Howell	... 8,941	A. C. Hay	... 7,700
J. H. Adam	... 8,594	W. H. Chadwick	... 7,694
E. E. Turner	... 8,497	F. A. J. Mackenzie	... 7,632
D. Squire	... 8,162	E. B. Loveluck	... 7,355
E. H. Jones	... 8,157	I. C. Boyd	... 7,315
S. R. Mayers	... 8,154	G. C. Denham	... 7,299
J. T. Mungovan	... 7,923	J. E. Brown	... 7,270
T. J. A. Craig	... 7,809		

The following have been declared to have obtained the first eight places in order of merit in the competitive examination held on 15th July and following days for eight appointments in the India Forest Service:—

	Marks		Marks.
H. R. Blandford	... 9,722	E. V. Ellis	... 7,868
R. N. Parker	... 9,548	M. R. K. Jerram	... 7,481
C. F. Bell	... 8,125	R. Livingstone Learmonth	7,286
W. Sidebottom	... 7,967	G. H. B. Walker	... 7,084

The Production of Pine-needle Oil in Germany.

THE Thuringian Mountains of Southern Germany are the home of the makers of pine-needle oil extract and similar products, which are used the world over for rheumatic and kindred complaints. For the manufacture of these articles on a small scale, an ordinary pharmaceutical distillery apparatus can be used; but for a large industry, specially designed apparatus must be employed, and a firm at Jena make these up to a capacity of about 2,725 quarts of pine needles. The needles and very young shoots of the various kinds of pine trees, more particularly those of the *Pinus pumilio*, are used for the manufacture of these products. They are collected in the latter part of May or the beginning of June, and are cut up into small pieces and placed in the cylinder of the distillation apparatus. Steam enters the base of the cylinder, and is conducted underneath the bottom, which is usually made of zinc, and is perforated, the central part rising in the shape of a cone or funnel. Through the perforations the steam finds its way to the needles heaped up in the cylinder, and the volatile oils contained there are freed, and make their exit, together with the steam, by means of a pipe which connects with the cooling cylinder. Cold water runs continually from the top into this cylinder, playing around the so-called "serpent pipe," and cooling its contents, and then finding an exit at the bottom. Thus, the contents of the serpent pipe become condensed, and the liquid runs into a bottle at the base of the cooling cylinder, where the oil is found swimming on the surface. The oil must from time to time be skimmed off, while the water runs out at another pipe. As this water is not entirely free from the oils, it is generally subjected to a rectifying process, in order to save the oil, which would otherwise be wasted, or the separation can be effected by the application of salts. In preparing the pine needle extract for medicating baths, when the steam has extracted the oils from the mass in the distilling cylinder, the condensed water (containing resinous, albuminous, and laminated substances) drops through certain perforations, and collects in a space below; thence it is drawn off by means of a tap, and taken by a pipe to a vacuum apparatus. The boiler is half filled with the condensed water, which by means of steam entering through a pipe and passing underneath the boiler, is heated and caused to evaporate. The process is greatly aided by the fact that the space above it is void of air, this having been drawn out by means of a pump. The evaporating process is continued until the contents have reached the desired consistency. The extract is then drawn off, mixed with pine-needle oil in order to give it the necessary perfume, and put up in jars. The mass left in the cylinder after both the above described processes are finished, is dried and put into a machine to separate and loosen the several fibres. These are then perfumed with pine-needle oil, put up in assorted packages, and sent to the different markets, where they are sold for pillow

and mattress stuffing. The fibre is considered very healthy and vermin-proof. —*Journal of the Society of Arts.*

Bottle-Trees as Fodder.

THE following interesting cutting from *The Pioneer* of the 15th June was sent to the Society for further information on the subject :—

"Trees as fodder.—A Brisbane newspaper says: The value of the bottle-tree as fodder for stock during times of drought has been brought under the notice of the Agricultural Department by Mr. E. Bowman, of Bauhiniavale, Taroom. He states that a trial was first made by a neighbour. Mr. Bowman was cutting down a tree for the leaves, when the sheep began to run after the chips, and so the tree was opened up, with the result, he says, that every head of stock "went mad over it." Mr. Bowman, although he has no grass, has brought 900 merino ewes on the strength of the discovery. Lambs eat it as well as the old sheep. An instance is given of a 15 years old pet wether without a tooth, growing fat since eating the tree. Any kind of stock will eat the wood after a little use of it. Mr. Bowman considers that it will soon be carried on the railway at fodder rates. He stated that cows which were almost dry from want of condition are now not only fat and strong but are giving a good yield of milk. Bottle-trees often contain from 50 to 100 tons of fodder. There are plenty of bottle-trees within easy reach of the railways. Mr. Bowman believes that hundreds of stock can be saved with it. The trees will keep for months in the log with the bark on."

The use of fanciful names of plants and trees in reports, etc., is greatly to be deprecated, as it leads to endless confusion and needless waste of valuable time in searching for the plant, or trees, most likely to fit the description. In the present instance several trees were referred to until it was thought that *Sterculia (Delubeckea) rupestris* (Sterculiaceæ), a native of north-east Australia, was the one alluded to. "It is allied to the Gouty-stem tree (*Adansonia Gregorii*), being thickened below, tapering upwards, or often swollen in the middle to the extent of 30 or 40 feet in circumference, with an apparently small tree growing out of its apex, so that it has been compared to the neck of a bottle. The gouty stem is soft and porous, and contains much mucilaginous gum, which is readily obtained by pressure, and is used as an article of food by the natives. It is also called Barrel tree." —*Journal of the Agricultural and Horticultural Society of India.*

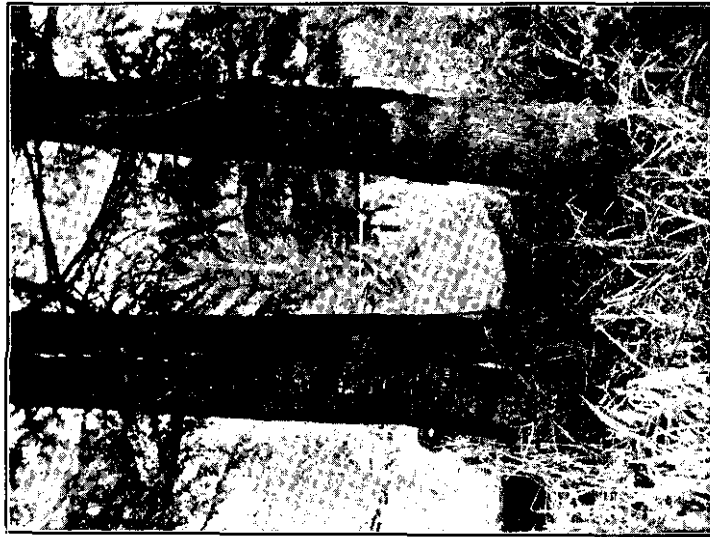
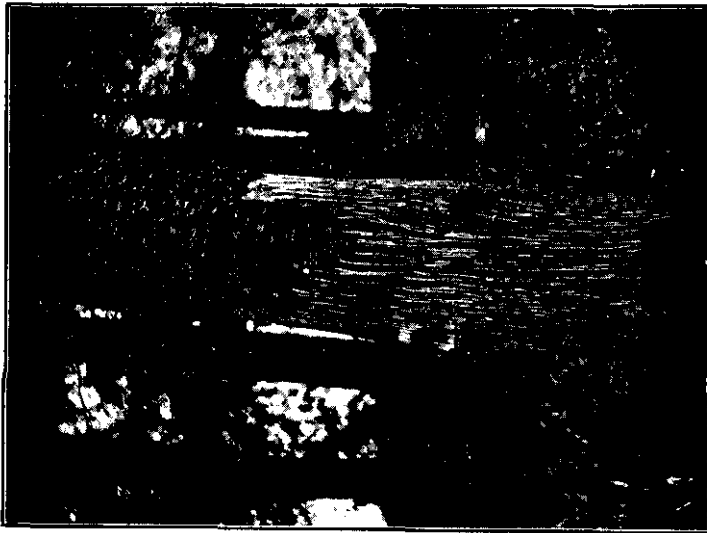
The Forests of Prussia.

Of the 86,151,083 acres of land in Prussia, 20,435,499, or 23 7 per cent. are occupied by forests and orchards. More than one-third of the area of Hesse, Nassau, Hohenzollern and

Brandenburg is covered with forests. In Schleswig-Holstein, on the other hand, forests occupy less than one-fifteenth of the area of the province. The ownership of the forests is as follows:—State property, 6,319,072 acres; Crown property, 178,950; forests partly owned by the State, 2,805; communal property, 2,727,109; forests owned by institutions, 242,089; forests owned by companies, 584,216; private property, 10,381,258 acres. The areas occupied by deciduous trees and trees of the pine family are respectively 6,317,446 acres, or 30.9 per cent., and 14,118,054 acres, or 69.1 per cent. Of the centre area of the kingdom, 7.3 per cent. is occupied by forests of deciduous trees, and 16.4 per cent. by those of the pine family. These forests yielded in wood since 1900, 861,000,000 cubic feet, in addition to 2,709,000 cubic feet of oak tanning bark, 3,408,000 cubic feet of osiers, and 1,809,000 cubic feet of other wood, a total of nearly 869,000,000 cubic feet.—*Journal of the Society of Arts.*

The Forests of Uganda.

A GOVERNMENT report just issued furnishes information with regard to the Mau Forest, which extends for about 33 miles along the line of the Uganda Railway. The forest contains an abundance of hardwood timbers—"too hard" is the complaint of those who have tried to work them. The Commissioner who is reporting, nevertheless, regards the forest as a splendid property, which will not, however, be realisable for many years. One of the conditions of a successful lumber industry are big rivers, down which logs can be floated to the mills, but there are no big rivers, it appears, in the Mau. Under these circumstances, residents in the chief town find it cheaper to line their houses with Norwegian timber than to use that of the local forest. The report refers to the rapidity with which eucalyptus trees grow in Uganda, specimens of eucalyptus globulus three years old having reached a height of 30ft.—*Timber Trades Journal.*



2 Deodar Trees "barked" by Black Bears at Deota, Jaunsar, U. P.

Photo. R. O. Coventry, F.C.H.

THE INDIAN FORESTER.

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[No. 12.

"Barking" of Deodar Trees by Black Bears.

CONSIDERABLE damage is done to deodar trees in Jaunsar, United Provinces, by black bears, particularly in the Deota forests. The bark is stripped off, leaving large exposed surfaces of wood, sometimes completely girdling a tree, and usually extending to a height of many feet above the ground. In some cases the tree is barked at a considerable height from the ground, evidently by a bear reposing in the branches.

The claw marks of the bear appear as white, streaky, vertical lines, close together, very clearly visible against the darker background of the resinous cambium.

I have never seen a bear at work in stripping off the bark, but am informed that its object is to get at the soft resinous cambium, which it feeds upon. Judging from the appearance of the wound, it appears that this is probably the case, and that after the bark has been removed, the wood surface is scraped by the bear's claws in order to remove the soft resinous cambium tissues, which it presumably eats.

If any one has observed a bear at work, it would be interesting to hear his account of it.

Blue Pine (*Pinus excelsa*) is also damaged in the same way; in fact this species appears to be preferred, as it is more often attacked than deodar.

There is an amusing tale current amongst the staff that the bears have only learnt this habit since the Forest Department commenced girdling Blue Pine!

The accompanying photographs, taken at the end of April, of freshly barked deodar trees, show the nature of the damage, the claw marks being clearly visible.

DEHRA DUN. }
17th September 1902 }

B. O. COVENTRY.

The Insect World in an Indian Forest.

BY E. P. STEBBING, F.L.S., F.E.S.

PART II.

*(Continued from page 409.)*ORDER II.—*NEUROPTERA*.

In this Order the adult insect is provided with a biting mouth. Two pairs of wings are present, usually furnished with an extensive system of nervures or veins which form a network in the wing. The metamorphosis is incomplete. Some of the members of the Order are wingless.

The *NEUROPTERA* comprise a comparatively small number of insects, including the Termites (the so-called 'white ant'), dragon-flies, stone-flies, May-flies, caddis-flies, lace-wing flies, ant-lions, &c., and the wingless bird-lice.

Present knowledge and observations on these insects tend to show that with the exception of the termites they are not of great importance as pests. For our purpose it will be sufficient to consider shortly six families, a seventh, the *Termitidæ*, being dealt with in somewhat greater detail.

FAMILY MALLOPHAGA.—BIRD-LICE.

These are flat wingless insects furnished with a large head; thorax usually of two, rarely of one or three segments; prothorax always distinct, hind body consisting of 8 to 10 segments in addition to the two posterior thoracic segments. The whole of the insects of this family live a parasitic life, creeping about on those parts that are near the skin, the feathers or hair of birds and mammals. They rarely come near the surface, so that they are not detected on a superficial examination. The legs are specially adapted for climbing amongst hair and feathers, as the last joint of the foot is hooked-shaped and can be bent back against the preceding joint; a hair can thus be held fast between the two joints. The eggs are fastened by the mother louse to the hairs, etc., of the host. These insects either suck the blood of the host or eat the fur or feathers. Lice multiply very rapidly on the bodies of human beings and animals when insufficiently cleansed, and under these circumstances more on sick and ill-nourished individuals than on healthy and well-nourished ones.

Suitable feeding and treatment and proper care of the skin are important. A solution of soda or rubbing the badly infected spots with soft soap and soda, washing them out after 24 hours, are cures, and will be found useful in the case of infected ponies or other livestock.

FAMILY TERMITIDÆ—TERMITES ('WHITE ANTS').

This family of insects live in colonies similar to the mode of existence pertaining amongst the True Ants and the Bees.

The *Termitidæ*, however, have no characters in common with these latter save a similar mode of existence, and the term 'White Ant' is, though a popular name for these insects, a misnomer, and its use is to be deprecated.

Each species of Termite is social, and consists of winged and wingless individuals. The four wings are, in repose, laid flat on the back, so that the upper one only is seen, except at the tips; they are membranous and very long, extending for some distance beyond the extremity of the body; the hind pair are similar in size and consistency to the front pair. Near the base of each wing there is a suture or line of weakness, along which the wings can be broken off, the stumps thus remaining as short horny flaps on the back. The neurulation is unlike that of other insects. It is very simple, consisting of two longitudinal nervures enclosing a space between them, like the mid-rib of a leaf. Smaller transverse veins take off on either side of them. The whole resembles a feather of a bird or a much veined leaflet. Wingless individuals are very numerous in the colony, and have the head and thirteen body segments distinct, the body being terminated by a pair of short cerci.

The integument is delicate and the chitinous plates are never very hard. The head is exserted and frequently of large size, sometimes as large as all the rest of the body together. Termites may be quite blind or may possess simple and compound eyes. The antennæ are moniliform, and short, and the legs are like one another.

The life history of the Termite or common 'White Ant,' *Termes taprobanes*, is commonly as follows:—

The insect lives in communities consisting of an enormous number of individuals. The adult forms found in a community are (1) workers, (2) soldiers, (3) winged males and females, (4) some of these winged forms which have lost their wings. In addition there are the young larvæ. The winged king and queen are only present for a few days. The individuals which have lost their wings are usually limited to one pair, the king and queen. These two may be recognized by the stumps of their cast wings, which are to be seen as small appendages on the dorsal surface of the thorax. The continuance of the nest is effected entirely by the king and queen. They are generally incapable of leaving the nest, more especially the queen, whose body swells up enormously after fertilisation to many times its original bulk. Great disorganisation occurs in the colony if anything happens to the royal pair, and in consequence of this certain individuals amongst the larvæ are kept in such a state that they can be quickly converted into royalties should it become necessary. It thus becomes obvious that the old theory that it was possible to get rid of a 'white ant' nest by digging out and killing the king and queen is quite untenable. When this is done, or when anything happens to the royal pair, the termites left in the

nest simply set about preparing a substitute royal couple. The soldiers may be distinguished by their very large heads and powerful mandibles. Their work is to guard the colony against enemies. The workers build the nest and look after the young larvæ. The males and females are produced in enormous numbers, and may often be seen at the commencement of and during the rains issuing from the nest in great clouds, either from the big earthen erections or stumps of trees in the field and forest, or from the base of walls, plinths, etc., of houses. On reaching the outside they proceed in a continuous stream upwards, and these gnat flights never fail to attract all the kites, crows, minas and other insectivorous birds in the neighbourhood, who stuff themselves to repletion with the food so easily obtainable. After this nuptial flight and their return to earth, those that escape their numerous enemies in the air, tear off their wings and pair should the pairing not have been gone through in the air. The now wingless insects then endeavour to find their way back to the original nest, and a few succeed, the greater proportion however being either killed off or dying in the attempt. It is to ensure the survival of the few that in all probability such enormous numbers of the winged individuals are provided. After return to the nest the body of the queen begins to swell up by a distension of the membrane between the chitinous plates, until it becomes like a sausage 2—3 inches in length, with the minute head and thorax at the top. She then lays a number of eggs daily, continuing this performance for a long period of time.

Termites never expose themselves willingly to daylight (except the king and queen during the nuptial flight) and consequently the workers make galleries to move about in. For their nests they build mounds of different shapes and sizes, these being sometimes several feet high. Such mounds are to be seen commonly over the whole of the warmer parts of India. They are formed of particles of earth worked up into a material which dries as hard as stone. Their nests are also made in the interior of trees, the wood being gnawed away and replaced by mud; beams and wooden floors of houses, etc., are also made use of in this way. When attacking a structure such as a post, the insects always work on the unexposed sides and in the interior, being very careful to leave all the external portions of the wood intact. This habit of theirs occasionally leads to serious accidents, roofs or heavy beams, etc., apparently sound, falling in without a moment's warning owing to their supports having been, unseen, entirely undermined by this pest. In the Forest large branches of trees may be seen to occasionally fall in this way, and examination shows that the apparently sound though dead woody branch is but a mass of earth enclosed by the outer portion of the rough bark, the entire interior having been removed and replaced by mud, every particle of which has been taken up the tree by earthen galleries running up, if the tree is still alive and healthy, on the outside of the bark.

Termites have also been reported as attacking seedlings of various species of trees in forest nurseries eating off the bark and thus killing the plants. An example of the damage they are capable of doing in this way has been recently brought to my notice. In the Lachiwala nursery in the Dehra Dun Division some young rubber plants of as much as 5 ft. in height and quite healthy were attacked by these pests and killed within a few weeks. An examination showed that the lower part of the stem just above the surface of the soil had been surrounded with earth and the bark beneath entirely eaten off two-thirds of the circumference of the stem, whilst in addition the woody interior had been badly riddled. The attack was not noticed until the plants began to bend over and die.

Prevention.—In countries where termites are common, wooden beams and supports of houses should be constantly and carefully inspected and tested to see that they are not being hollowed out or undermined by the pest. Wooden posts used as supports to bungalows in the forest should be thickly tarred on the ends placed in the ground, and once a year these ends should be exposed by removing the soil and fresh tar laid on, a small pool of tar being formed round the end in contact with the soil. The wooden parts above soil should be constantly inspected, and all mud galleries running up them be brushed off, as the termites will give up the attack once they are exposed to light.

Remedies.—When the 'white ants' are troublesome in bungalows or nurseries careful search should be made for their nests, the earthen galleries, under which the insects are doing the damage, being traced back to the point they emanate from. The nest having been found, all save one or two large openings should be closed and some pieces of carbon bisulphide be pushed into the unclosed openings, which should then be sealed up. The fumes will sink down through the nest and entirely exterminate the colony. Care must be taken to (1) close all the openings and (2) not to breathe the vapours given off by the carbon bisulphide.

In houses tar well all stone, earthen or wooden floors, both round the edges and up the walls for a few inches and in the centre before laying down mats, carpets, &c. These latter should be removed at intervals, depending upon the abundance of the pest in the neighbourhood.

In the case of larger nursery stock like the above alluded to young rubber saplings and young roadside saplings and poles, the mixture known as 'Gondal Fluid' should be made use of. It is prepared as follows:—1 part *dekamali* gum (this is the resin of *Gardenia gummiifera*); 2 parts *asafœtida* (*hing*); 2 parts bazar aloes (*gugul*); 2 parts castor oil cake; pound these together and mix up thoroughly; then when the mixture is decomposed into a thickened compound, add water till it is of the consistency of paint. Some colouring material such as ochre should be added so that the material can be seen

when put upon the trees. When ready the mixture should be painted upon the trees in a continuous band 2 ft. to 3 ft. high, starting from the surface level of the soil, care being taken that all interstices in the bark are coated with it. The earthen tunnels of the termites should be first scraped off. All the materials of the mixture can be procured at slight cost in the bazar.

FAMILY PSOCIDÆ.—BOOK-LICE, DEATH WATCHES.

Minute insects with slender thread-like antennæ consisting of from 11—25 joints. Prothorax is very small and concealed between the head and the mesothorax. Four delicate membranous wings are present, the upper pair being the larger.

The small insects found amongst dust and books belong here. A small psocid is extremely plentiful on the leaves of the sal (*Shorea robusta*) tree in the Dun Forests during the latter part of February. Small brown patches of rotten tissue appear on the leaves, but whether these are due to the insect or whether the insect is merely feeding upon a fungus which is causing the discolouration has yet to be determined. The insect is a minute yellow one, both wingless larvæ and winged individuals being present. The family has up to date only been reported as feeding upon rust fungi, vegetable refuse, etc.

FAMILY ODONATA (LIBELLULIDÆ).—DRAGON FLIES.

Elongate insects with a very mobile head and large eyes, strong mandibles and a broad lip, the antennæ being small, inconspicuous, and ending in a bristle. Wings, four in number and elongate, of equal size, and similar texture. All the legs are placed more anteriorly than the wings. The earlier stages of their life are spent in water, the larvæ breathing by means of tracheal gills. The metamorphosis is incomplete, but there is a great change in the appearance of the insect at the last moult. The attachment of the head to the thorax is such that it enables the insect to move the former round with great ease. The eyes are often enormous and occupy the greater part of the head. Three ocelli are present.

The family is carnivorous, and the mature insect catches its prey on the wing. The eggs are deposited either in water or on the stems of some aquatic plant. The young on hatching out have no wings and are quite unlike the mature insect. The wings begin to appear at the fourth moult or change of skin. The family is not of importance economically.

FAMILY EPHEMERIDÆ—MAY-FLIES.

Delicate insects with short antennæ, four membranous wings, the hinder pair smaller than the front ones. The adults can be easily distinguished by the possession of two or three very elongate slender tails terminating the end of the body. The earlier stages of the life are passed in water, the larvæ consequently differing greatly from the adult.

The May-flies are not of economic importance. The appearance of the adult in English trout streams is eagerly looked for by the keen fisherman, and the insect would appear to be equally abundant and sought after as an article of diet by the fish of some, at any rate, of the Indian rivers and streams. The study and working out of the life-history of the Indian species would not unlikely well repay the ardent fisherman in this country.

FAMILY HEMEROBIIDÆ - ANT LIONS, LACE-WINGED FLIES, ETC.

Insects with a vertical head; maxillæ free with five-jointed palpi; the labial palpi three-jointed. Wings equal in size and highly net-veined. Tarsus five-jointed. The metamorphosis here is exceptional, being almost complete. The larva has mandibles and maxillæ forming spear-like organs, which are also used for sucking. The insects have in fact a suctional mouth in the earlier stages of their life-history and a biting one in the adult. This is unusual and the reverse of what occurs in the *Lepidoptera* and other big Orders.

The pupa has the general form of the imago, and is enclosed in a cocoon.

These insects live on land in all the stages of their existence.

In the *Myrmeleonides* (ant-lions) the antennæ are short, clubbed and the apical space of the long wings contains regular oblong cellules in it. These insects are interesting owing to the fact that the remarkable habits of the larvæ have been known to naturalists for over two centuries. The larvæ are predaceous and secure their prey by means of inverted cone-shaped pit-falls, which they excavate in sandy places and at the bottom of which they bury themselves, leaving only their elongate jaws projecting out of the sand at the bottom of the pit. The latter being constructed in dry loose sand, an insect running along the ground and reaching the edge slips on the moving sand and falls into the pit, to be impaled on the sharp mandibles of the larva, who then sucks out its juices. Even should the insect not be impaled upon the mandibles, the ant-lion larva will secure it before it has managed to escape up the shelving slipping sides of the pit. These insects are common in many parts of India, more especially in dry sandy river-beds, etc.

The *Chrysopides* (lace-wing flies) are fragile insects with elongate bristle-like antennæ. They have metallic red-coloured eyes, by which they can be recognized. They are of no importance as far as present observation has shown.

FAMILY PHRYGANEIDÆ.—CADDIS-FLIES.

The wings are more or less clothed with hair; the hind ones are larger than the front which are held in a roof-shaped manner over the body when at rest. Antennæ are thread-like, mandibles are absent. The metamorphosis is nearly complete. The larvæ are caterpillar-like, usually inhabiting cases of their own construction. The pupa resembles the perfect insect.

These insects have the appearance of small black moths (*Lepidoptera*) and are to be found in the neighbourhood of water, in which the larval stage is passed.

USEFUL NEUROPTERA.

The Order cannot be said to contain many insects of use to the Forester. The dragon fly, in its adult condition, and the ant-lion larva are both carnivorous, and prey upon insects and both probably do a certain amount of good by catching and feeding upon noxious insects pests. It is not improbable, however, that they also in this way kill off useful insects. The dragon-fly catches its prey entirely upon the wing.

An Interesting Bamboo.

THE climbing bamboo, *Melocalamus compactiflorus* (*Pseudostachyum compactiflorum* of Kurz), called by the Kachins *Nachinwa*, is found on the hills at Sinlemkaba at a height of 6000 feet. It is frequent on the high hills on the borders of China, and is indubitably found on the other side from the fact that shoes or sandals are made out of it. The shoes appear as if made out of grass. The bamboo is stripped in a green state and the resulting thread or yarn is very pliable and soft. It is twisted into strands, and the shoes or sandals are made by interlacing the strands. Almost all Kachin, Shan and Chinese traders who travel to Bhamo and back with their caravans wear these shoes.

The bamboo has flowered, and consequently green specimens of the stems are not obtainable. The flowering branches are thrown out from the nodes and the very small flowers appear in clusters or rosettes. When the flowers are over, they are succeeded by globular fruits, and on the same branchlets could be seen both the small fruit, evidently just formed, and the large mature caryopsis, the seed of which had germinated whilst attached to the branch, putting out a tuft of roots and a shoot prior to falling to the ground, whilst others again had fallen and taken root. Kurz in his *Forest Flora* describes the seed thus: "caryopsis very large, more or less globular, the pericarp thin and coriaceous." The fruit is much like a wood apple in shape and the testa is somewhat leathery—"seed large, mealy-fleshy." This it is, and resembles much the edible chestnut, but is not as sweet to the taste. Kurz further states that the culms are very strong, but does not mention whether they are hollow or woody throughout. The culms, so far as I know, are woody throughout;* the internodes vary from 12 to 18 inches and may even reach 2 feet in length, probably doing so in fine specimens grown under favourable conditions.

On the habitat of *Pseudostachyum compactiflorum* Kurz says:

* The culm sent us is solid except at the very top. It is about 36 feet long. The bamboo was identified by Mr. J. S. Gamble, C.I.E., F.R.S.—HON. ED.

"Frequent in the drier hill forests of Mattaban east of Tounghoo at 4000 to 6000 feet elevation, rarely descending to 3000 feet." But the bamboo now in question is *not met* with 500 feet below Sialemkaba, which is a little over 6000 feet. Sialemkaba is an isolated hill, *i.e.*, not on the main chain of hills but on an off-shoot, in a direct line about three to four miles in the direction of China. The next high peak is Narroboom, 9000 feet, but the bamboo is not found in the dip between, though as one ascends, I understand, it is again met with.*

BUAMO, 27th July 1902. _____

F. G. R. B.

Indian Pheasants and their Allies.

By F. FINN, B.A., F. Z. S.

(Continued from page 229.)

CHAPTER IV.

THERE remain four more long-tailed pheasants to discuss, most of which are rare and little known in India. The first two are typical pheasants, belonging to the same genus as that which includes the well-known bird at home. In this group (*Phasianus*) both sexes are very similar in form, though they differ absolutely in colour; but the males are larger than the females, have short sharp spurs, and much longer tails. The tail in both sexes has the middle feathers much the longest, the others rapidly diminishing to the outer pair; and the long central feathers are transversely arched, so that they form a roof over the flat feathers below, the whole tail thus looking very narrow and pointed. The cocks have a red bare skin round the eye, and there is sometimes some of this in the hen. They show off in the sideway slanting posture. The pheasants of this group are active birds, strong on the wing and ready to rise; they will live anywhere where there is moderate cover, but avoid heavy forest. They are characteristic of temperate regions as a rule, and are the best game birds of the whole family.

MR. HUME'S PHEASANT.

Phasianus humiae, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 80. Native name—*Loe-nin-koï*, Manipur.

The general colour of the male in this species is a rich bay with a golden gloss; the head and neck are steel blue, and the rump steel blue with white edgings to each feather, giving a beautiful scaled appearance; there are two white bars across the wing, with a broad patch of steel blue between them; the tail is grey, crossed by bars of mixed black and chestnut. The bill is greenish, eyes orange, and legs brown.

The hen is mottled with drab, sandy, and black, and has the outer pairs of tail feathers chestnut with white tips, and imperfectly barred with black.

The male is about thirty-three inches long, about twenty inches being taken up by the tail; the closed wing measures about eight and-a-half inches, and the shank nearly three. The hen has a very much shorter tail, this being only seven inches long; but her wing is only about half an inch less than the cock's.

Mr. Hume discovered this bird in Manipur about twenty years ago, in 1881. He only got two specimens, both males, and very few have since been procured. The species has, however, been found to also inhabit the Ruby Mines District in Upper Burma, as also the Shan States.

Burmese male birds commonly have the white edging of the rump-feathers so much broader than in the typical birds, that the whole of that part of the back looks silver-white rather than scaled as in the ordinary form, but I do not consider them distinct, although Mr. Oates has named the Burmese bird—just distinguished as a variety by me—as a distinct species.

But whichever of us is in the right, the species remains as yet a rare one; nothing is known about its nesting, and no specimen has ever been received at a zoological garden, so that anyone who gets hold of a live bird should take care of it and send it on to the London Zoo, if possible.

STONE'S PHEASANT.

Phasianus elegans, Blanford, Faun. Brit. Ind., Vol. IV, p. 81.

The male of this species has two little erectile ear-tufts, one on each side of the head, like the common pheasant of England, to which it has a great general resemblance, having the same green and purple head and neck and chestnut upper back and flanks, the latter spangled with purple black; the tail also is similar, light brown with black bars. But the small wing-coverts, which are sandy in the English pheasant, are French-grey in the present bird, which also has the rump or lower back gray and green instead of maroon. Moreover, the glossy green black of the lower breast extends in this species right up to the green neck, whereas in the home pheasant the upper breast is bay with purple edgings to the feathers.

The legs are lead-coloured, and the bare skin of the face scarlet. The hen is mottled with black and pale drab, much like the hen of the well-known pheasant at home. The absence of chestnut on the outer tail-feathers will distinguish her from the hen of Hume's pheasant.

The cock is about twenty-seven inches long, with a nine-inch wing and sixteen-inch tail; the shank is about two and a half inches, and the bill one and-a-quarter. The hen is decidedly smaller, with a much shorter tail in proportion, this measuring only nine inches—an inch longer than her closed wing.

This pheasant was first known from the province of Szechuen in Southern China, but was almost simultaneously found, by Dr. J. Anderson, the first Superintendent of the Indian Museum, at Momien in the Yunnan province, where it was common on grassy hills at an elevation of five thousand feet. Recently it has turned up in Burma, at about the same elevation, in the Northern Shan States, where one was shot by

Lientenant H. R. Wallis. This, then, is another rare bird which needs looking out for—not that it is particularly interesting scientifically, for all these green-necked, long-tailed pheasants are hardly more than varieties of one type, and inter-breed indiscriminately when they are brought into contact. This has, as many people know, already happened in England, where the introduction of the ring-necked pheasant of China (*Phasianus torquatus*) has completely mongrelized the old Colchican pheasant (*P. colchicus*), which is believed to have been introduced by the Romans. However, from a practical point of view the pheasants of this type deserve every encouragement, as they will thrive almost anywhere and afford the best of sport, besides being uncommonly good to eat. Indeed, in localities in India of a suitably temperate climate, if no pheasants of good sporting character exist, I should strongly advise the introduction of the above-mentioned Chinese ring-necked species, which can be procured to order in Calcutta at very reasonable rates, and is a particularly hardy and adaptable variety.

LADY AMHERST'S PHEASANT.

Chrysolophus amherstiae, Ogilvie-Grant, British Museum Catalogue of Birds, Vol. XXII, p. 342.

The male of this species is a remarkable-looking bird, not to be mistaken for anything else, though the hen is not at all striking. The cock has a long narrow crest from the back of the head, a cape or ruff (which can be spread out like a fan) covering the back of the neck, and an immensely long tail, with the centre feathers particularly long and broad, and arched transversely, so as to roof over the rest, in an even more marked manner than in the birds already described. Indeed, in the Amherst, the top tail feathers form a sort of gabled roof for the rest. The upper tail-coverts are also very long, and lie along the sides of the tail like the "side hangers" of a cock. The bare face, of a livid blue or green, is almost the only point which this very over-dressed bird shares with the hen of his species.

If his attire were less exuberant, Lady Amherst's godchild would still attract attention by his startling colouring. His crown, throat, breast, upper back, and wings, are rich metallic dark green, with black edgings to the feathers; the under-parts below the breast are pure white. The ruff is white, with black edgings to each feather, and the enormous centre tail feathers are also white, with black bars and pencillings; the side tail feathers are less pure and less distinctly marked. The whole is set off by the blood-red crest, scarlet tips to the long upper tail-coverts, and by the lower back being yellow, bordered with scarlet.

The eyes are white, and the legs bluish like the face. The length of this bird is over four feet, but a yard of this is tail;

the wing barely exceeds eight inches, and the shank three; it is a smaller and lighter-made bird than the home pheasant.

The hen is brown, boldly barred with black, especially upon the upper surface of the body. She has a bare bluish or greenish space round the eye, and grey legs, like the cock, but her eyes are dark. Her zebra-like markings will easily distinguish her from the hen of Stone's pheasant, the only one for which she could be mistaken. Besides, her tail is much longer in proportion than that bird's, being more than a foot long, although she is a smaller bird.

This remarkable bird is one of the latest additions to the fauna of our Empire, having only been introduced to our notice in 1899, by Mr. Oates, who had an opportunity of inspecting a male specimen which had been obtained by one of the officers attached to the Boundary Delimitation Commission, on the Burmo-Chinese frontier.

The proper habitat of the species is the mountains of Western China and Eastern Tibet. It was introduced into Europe alive a good many years ago, and is probably now better known as an aviary bird than in the wild state. In captivity it breeds freely with hens of the well-known golden pheasant (*Chrysolophus pictus*), its only near ally, and the hybrid excels both of the parent species in beauty, presenting all the colours of both without confusion or intermixture.

In the crest, indeed, the red of the Amherst and the gold of the other species blend into a fiery orange of remarkable beauty; but there is no mottling, the colour being of an even shade.

This splendid hybrid is completely fertile, either with the parent stocks or with other similarly bred hybrids. Considering the very distinct appearance of the two pure species, this is a very remarkable fact, and not as well known as it should be; many people still believing that all true hybrids are barren.

A curious story is told by the Chinese of the intelligence of the Amherst pheasant in the wild state. They say that when snares baited with grain are laid for these birds, they will endeavour to sweep away the bait with their long tails in order to eat it without risk of capture. This, I must admit, sounds most improbable; but birds really do such extraordinary things at times that one has to be careful not to be too incredulous. Only the other day, when keeping a number of the pretty little Liothrinx or Pekin Robin (*Liothrinx buteus*), so common in our hills, I found that they had the extraordinary habit, when they got hold of a black ant, of turning their tails forward and pushing the insect into the feathers, two or three times, before swallowing it. This, I presume, was to make the ant work off the venom of its sting; some of them would do it even with the small black house-ant,

but every one to which I gave the big garden species always performed the trick, which is one of the most remarkable I have ever seen. The ordinary red house-ants they would have nothing to do with.

To return to the pheasants. Mr. Oates in his *Manual on the game-birds*, reasonably suggests that the golden pheasant itself may be at some time found within our limits, as it naturally inhabits the mountains of Southern and Western China. The cock, which has long been a well-known fancy bird both in India and Europe, is chiefly golden above and scarlet below; he is ruffed and crested like the Amherst, the crest being fuller than in that bird; but his tail is not so large. The hen is extremely like the Amherst hen above described, but has dull yellow legs and no bluish bare skin round the eye. Moreover, the general tone of her plumage is yellower, and there is a wash of gold on the top of her head.

THE CHEER PHEASANT.

Catreus wallichii, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 82.

Native names :—*Chihir*, *Chir* Nepal, Kumaun, Garhwal, &c.; *Bunchil*, *Herril*, N. of Mussoorie; *Chaman*, Kulu and Chamba.

The Cheer bears a close general resemblance to the typical pheasants of the genus *Phasianus* above described, having the same style of tail and no ruff; but the head is furnished with a long narrow-pointed crest in both sexes, which also have in common a bare red skin round the eye. This style of head is characteristic of some *Kalceges*, as will be seen in the next chapter; and its combination with the long narrow true pheasant tail makes the Cheer quite unique and easily recognizable. The male Cheer is larger than the female, and is spurred; but the latter has nearly as long a tail in proportion, and is not much duller in colour, though different in pattern: the cock Cheer being an unusually dull bird for a pheasant.

His general colour is a buffy white, closely barred with black above and sparingly mottled with that colour below; his head is drab, and the front and sides of his neck plain dirty white; the lower part of his back is warm buff barred with steely black, and his tail is really handsome, being rich buff barred with broad bands of mixed chestnut and black. The middle of the belly is black, and the flanks rusty yellow.

The bill is pale grey-brown, and the feet drab.

In length the cock measures about a yard, and although nearly two-thirds of this is tail, he is yet really a considerably bigger bird than the English pheasant; having a ten-inch wing, the shank nearly three inches, and the bill about half that.

The hen has the same dark cap and white throat, the former rather obscured by light edges to the feathers; but the neck and breast are black with pale edges, and the general body colour darker than in the cock, and rather mottled than barred, with longitudinal streaks of buff; the tail is also irregularly mottled and barred with brown, black, and buff; the lower part of the breast is plain chestnut edged with buff.

The hen is about two feet long or more, with a tail of over fourteen inches, and a wing of nine.

In contrast to the three rarities I have just been dealing with, this is a well-known bird all through our hills, though somewhat local. With us it occurs from Chamba to Khatmandu, and it is not known outside these limits. It is a bird of moderate elevations, ranging between four and ten thousand feet according to seasons; it is particularly partial to wooded precipices, and very constant to localities which suit it. It is a sociable bird, flocks of from five to fifteen being commonly found, except in the breeding-season, and both sexes crow. The note is varied, but generally includes repetitions of the bird's name.

This pheasant is especially a root-eater, and it also feeds on berries, seeds, and insects, but not on leaves and grass. It breeds from April to June, laying up to fourteen eggs of a pale stone colour, usually speckled with brown at the end, and just over two inches long. The male Cheer has not been seen to show himself off to the female; but as one we had recently at the Calcutta Zoo used to assume a slanting posture, with his fine tail spread, when anxious to fight a visitor, I conclude that he was simply following the display habit of his species. For, as a rule, a bird has only one set of gestures to indicate hatred for a rival and affection for the gentler sex, and so the fighting and love-making postures come to be very much alike, as may be easily seen in that bird of generally unregulated emotions, the domestic turkey. Even with ourselves, the blush tinges not only the maiden's cheek but also that of the infuriated fish-wife!

CHAPTER V.

KOKLASS AND KALEEGES.

The Koklass, although they come under the heading of pheasants with medium tails, bear a stronger general resemblance to some of the long-tailed species I have been dealing with. Both sexes have the head entirely feathered, and the body plumage pointed in shape. The tail is pointed, both with regard to its individual feathers and its general shape, the centre feathers being the longest and the outside the shortest. The wings are longer and more pointed than in any other pheasant,

the primary or pinion-quills showing noticeably beyond the secondaries when the wing is closed, unlike what is usually the case in this family.

The cocks are altogether different in colour from the hens, and stand higher on the leg, which in them is spurred. They have, however, only one piece of special feather-ornamentation, though this is a sufficiently remarkable one; for it consists in the male having three crests, one long, one growing from the crown, and two still longer, which flank it on each side. I have never seen any description of the display of the males, but it ought to be interesting. The hens have a short ordinary crest.

THE COMMON KOKLASS OR PUKRAS.

Pucrasia macrolopha, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 85.

Native names:—*Plus*, Kashmir; *Kukrola*, Chamba; *Koak*, Kulu and Mandi; *Koklus*, *Kokla*, Simla to Almora; *Pokras*, Kumaun, Garhwal and W. Nepal.

The cock of this species has a dark green head, with the central crest fawn colour, and a white spot at each side at the commencement of the neck. The front of the neck is chestnut, and this colour extends right down the breast and belly, becoming paler behind. The rest of the body plumage is streaked with black and grey, the former colour occupying the centre of the feathers, and the latter the edges. The centre tail-feathers are reddish brown, and the others black with narrow white tips, and running into chestnut towards the root.

The Koklass, however, is a very variable species, especially with regard to the breadth of the chestnut colouring on the underparts and the proportions of the black and grey in the body feathers. In the typical bird, as found in the N.-W. Himalayas, the black centre stripe is about as wide as the grey edging, but in Western Nepal specimens the black is much increased, and the chestnut shows a tendency to extend to the back and sides of the neck. But the two forms run into each other. Again, the race from Western Kashmir combines this extension of the chestnut neck colour with the narrow black stripes of the type. All these variations have been named as species, the North-West Himalayan bird being the true *Pucrasia macrolopha*, while the dark Nepal form is *P. nepalensis*, and the Kashmir bird *P. biddulphi*.

The length of the cock is about two feet, with the wing just over nine inches and the tail about ten; the shank measures about two and-a-half inches and the bill about one and-a-half.

The hen is mottled with black and brown, with buff streaks above; her eyebrows are buff, and her throat pure white; below she is buff with black streaks, and the middle of the belly white;

the side tail-feathers are black, tipped with white and edged with chestnut outside. The hens are much the same everywhere, except that in the Nepal variety there is often much more chestnut in the tail.

The short, flat-pointed tail, feathered face, and long wings will easily distinguish the hen Koklass from other hen pheasants.

She is about three inches shorter than the male, with an eight-inch tail, and wing only a little longer; the shank is two and-a-quarter inches.

The Koklass is confined to the Himalayas, from Jumla in Western Nepal to Kashmir; its range is from about four thousand feet to the forest limits. It is pre-eminently a forest bird, and lies close till flushed, when it flies with great rapidity and is hard to shoot. Although living on a mixed diet like most pheasants, it has an especial preference for leaves and buds; it is supposed to be our best pheasant for the table.

It has apparently named itself, like so many Indian birds, the crow of the male being compared to the words "*kok-kok poprass*." He usually crows in the morning and evening, but will also answer a gunshot or a peal of thunder—a not uncommon habit with pheasants.

The breeding season is from April to June, and the birds are then found in pairs; in autumn and winter they collect into coveys.

The eggs are about nine in number, pale buff, often marked with reddish spots of varying size, and two inches long. No nest of any sort is made, the eggs being deposited in a "scrape" on the ground.

THE CHESTNUT KOKLASS.

Pucrasia castanea, Blanford, Faun. Brit. Ind., Vol. IV, p. 86.

I mention this species because it is believed to occur in our Empire; but very little is known about it, only two specimens, now in the British Museum, having ever been obtained. These are said to have been obtained from Kafiristan, and the bird is also credited with inhabiting Yassin, Chitral, and Swat.

It differs from the common Koklass in the much greater extension of the chestnut colour, which runs all round the neck, extends some way down the back and covers the flanks as well as the breast; the middle of the belly being black.

The hen appears to be still unknown, so that there is a good deal to be made out about the species yet. Of course, there is always the possibility of its turning out to be a mere rufous variety of the common Koklass, just as the Nepal bird is a dark

variety. The common grey partridge of Europe (*Perdix cinerea*), which has certainly not more chestnut in its plumage than the ordinary Koklass possesses, sometimes produces a variety—formerly named as a species, *Perdix montana*—which may be almost all over of a rich chestnut colour.

The Kaleeges form a large genus of pheasants which are very easily recognizable. In all both sexes have a crest, and the sides of the face covered with bare red skin, which in the cocks, at all events, is extensible upwards and downwards. The tails in all the species are folded like that of a common fowl, and in most of them are not much longer than an ordinary hen's tail; but in the males the top feathers have a decided curve, and in two of the species the tail is quite long in that sex. The cocks are well spurred, and are hard fighters; they have a curious habit of buzzing with their wings as a challenge.

As sporting birds, the Kaleeges are not to be commended. They won't rise if they can possibly help it, and as they live in jungle, can make their arrangements for skulking in safety, and do so. They do not range so high as the other pheasants, and sometimes even inhabit the plains.

To the naturalist some of the species are of the highest interest, as they exhibit so many gradations that it is doubtful how many kinds there really are. This, however, is not encouraging to the beginner who wishes to precisely identify whatever birds he may get. It is very probable that a good deal of interbreeding goes on, with the natural result of the production of a set of mongrels, since the crosses bred from these nearly allied birds are probably fertile.

About the first three species there is, however, no doubt; the males of these all have tails much like an ordinary domestic hen's, as described above, and their plumage is always black, or rather steel blue above and greyish white below, the white feathers of the under-surface being conspicuously pointed. Their legs are never red or pink.

The hens of these species are all very much alike, hardly to be distinguished at all in fact. Their tails are almost completely fowl-like and their crests narrow and projecting; their plumage is of a nut brown, with light shafts and tips to the feathers; the tail feathers, except the centre or uppermost pair, are black. The plumage has a much more uniform appearance than that of other hen pheasants, the light markings being so small that the birds appear plain brown by comparison with these.

THE WHITE-CRESTED KALEEGE.

Gennæus albicristatus, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 89.

Native names :—*Kalij*, *Kukera*, *Mirghi Kalij*, *Kalesur* (male), *Kalesi* (female), Hind. in the N.-W. Himalayas; *Kolsa*, in the N. Punjab and Chamba.

The male of this species has a long, narrow drooping crest of white hairy looking feathers; his upper plumage is black, glossed with blue, and his tail black; the rump is barred with white, the feathers being white tipped, and the under-surface is dirty white, the throat and belly being blackish brown. The hen is brown as above described.

The bill of this bird is greenish white, and the legs dirty white also. The cock measures from two to two and-a-half feet in length, of which the tail is about a foot. The wing is over nine inches, the shank three, and the bill about one and-a-half. The hen ranges from about two feet down to twenty inches, her tail and wing being each about eight inches long.

This species inhabits a zone, from two to ten thousand feet in elevation, according to the season, from Kumaun to Hazara in the Himalayas; it is said not to be found west of the Indus, and of Nepal it only penetrates the westernmost portion, if it is found in that country at all. Of all the hill pheasants this most affects the neighbourhood of man; but it is nevertheless not easy to domesticate. It breeds from April to June, the hen laying about nine cream-coloured eggs in a rude grass nest on the ground. The eggs are about two inches long.

THE NEPAUL KALEEGE.

Gennæus leucomelanus, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 90.

Native names :—*Kalij*, Hindi; *Rechabo*, Bhutia.

This species is blue-black above and white below, with a white, barred rump, like the last; but it has a black crest. The hens are practically indistinguishable, and the dimensions differ very little, though the present species is slightly the smaller. The legs are horny grey, darker than in the white-crested Kaleege; the face of course red, as usual in this group.

This is the only Kaleege found in most parts of Nepal, its nesting habits and eggs appear not to be recorded.

THE BLACK-BACKED KALEEGE.

Gennæus melanonotus, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 91.

Native names :—*Kur-rhyak*, Lepcha.

This species resembles the last in size and in having a black crest, but differs in having the upper surface entirely rich blue-black, with no white edgings on the rump.

The hen is like that of the preceding species.

The present bird inhabits the Sikkim Himalayas, extending on the one side into Eastern Nepal and on the other into Bhutan, but its exact range is not yet known. It is, like the others, a bird of moderate elevations.

It breeds from March to July, according to the elevation it inhabits, and apparently differs from the white-crested Kaleege in making no nest at all and often laying fewer eggs.

As will have been seen, the Nepal Kaleege is intermediate in colour—as it is in geographical range—between this species and the white-crested, having the black crest of the present bird and the white-barred rump of the white crested species. It has therefore been suspected of being a hybrid between these two by Blyth and Jerdon, but the researches of Dr. Scully have removed the bar sinister from its escutcheon. It is perhaps just as likely that it is the ancestor of the other two.

VI.—EXTRACTS, NOTES AND QUERIES.

Destruction of Greek Forests.

(From the Times' Athens Correspondent.)

DESTRUCTIVE forest fires are announced from every part of Greece—from the Morea, from Thessaly, from Ætolia, and from the slopes of Pindus. The exceptional heat of the present season and the high winds now prevailing have largely increased the area of devastation, and in some instances, perhaps, have been the direct cause of these catastrophes, spontaneous ignition, it is said, resulting from the friction of the dry branches. There can be little doubt, however, that the conflagrations are for the most part due to human agency. In some cases the woods are deliberately set on fire by the peasants for the purpose of making clearances for arable land, or by the shepherds in order to increase the extent of pasturage; in other cases conflicts between neighbouring communes over the right of cutting timber have led to wanton acts of incendiarism, while lighted matches or cigarettes thrown carelessly into thickets, or sparks from the fires in the shepherds' cantonments are often productive of widespread destruction.

These calamities demand the serious attention of the Greek Government. The loss resulting from the destruction of a potential source of considerable national wealth is insignificant compared with the rapid disfigurement of the country and the deterioration of the climate. Her natural beauty is an asset of incalculable value to Greece, second only to her historic and artistic associations, and it is impossible to witness the conversion of her

loveliest districts into arid wildernesses without feeling that a most important factor in the future prosperity of the country is being recklessly sacrificed. The injury to the climate is a still more serious matter. When the woods, which serve as reservoirs of moisture, disappear, rain becomes less frequent but more violent, and long droughts are followed by cataclysms which complete the denudation of the mountain slopes already begun by the hand of man. The surface soil, deprived of its natural shelter, is washed away, and the rapid descent of the water into the plains causes disastrous inundations. Thus the process of destruction, once initiated, goes on automatically, and cause and effect react on each other.

In recent years this grave question has begun to attract some notice in Greece, but little has yet been done to remedy the evil. A society for the reafforestation of the country has been formed under the presidency of the Crown Princess Sophia, who takes a lively interest in every beneficent and useful project. It seems unlikely, however, that any great success will be attained by the voluntary agencies. With the utmost care, the destruction wrought by one of these vast conflagrations can scarcely be made good within a quarter of a century; in many cases it is practically irreparable. The protection of the national forests rests with the Greek Government. A recent circular issued by the Ministry of Finance draws a lamentable picture of the incompetence and culpable indifference of the officials charged with this important duty. It appears that little is done to check the encroachments of the peasants and shepherds, to hinder the indiscriminate cutting of timber, or to prevent the conflagrations. The discovery and arrest of the incendiaries is, no doubt, a difficult task, but, should other means fail, the imposition of a fine on the districts in which the conflagrations take place might be productive of good results. It may be remembered that a similar system proved efficacious in Ireland at the time of the Land League outrages.

Our correspondent at Athens calls attention in a letter which we print to-day to a process going on in Greece which is not without parallel in many other parts of the world. Greece was formerly in large measure a land of forests. Its equable climate was often praised by ancient writers, and yet in modern times it presents sharper contrasts of temperature and season than other European lands in the same latitudes. So far as these contrasts are due to the physical configuration of the country they must have existed in ancient times no less than in modern. But the influence of forests in moderating extremes of temperature is a well-known fact of meteorology. If, then, the climate has changed as the forests have gradually been reduced in area, the two facts may fairly be associated in the relation of cause and effect. The gradual disappearance of primeval forests is a phenomenon generally concurrent with the growth of population. As man advances, the trees recede. First the plains are occupied

and agriculture demands the clearance of the land from trees. Gradually man encroaches on the hills, and again his advances are marked by the gradual disappearance of the forest. This is peculiarly the case in Greece, where no spot in its plains is more than ten miles from the surrounding hills. Its ancient forests have disappeared for the most part, but it is still, comparatively speaking, a well-wooded country. Its woodlands occupied some 15 per cent. of its area in 1860, and this is about five times as much as the area under woodland in Great Britain.

But man is the enemy of the forest in all parts of the world. It is too often sacrificed to his ignorance and his carelessness, when it does not fall a victim to his greed, or even to his malice. It is so easy to destroy a forest and so difficult to restore it. When a clearance has to be made, nothing is so easy as to set fire to the woodland, nothing so difficult as to confine the conflagration within legitimate bounds. Bush fires, as they are called, are of daily occurrence in the *West Indian* islands, and many are the efforts which the Colonial Legislatures have made for their repression or, at least, for their regulation. When a negro peasant wants a piece of land for the cultivation of his "ground provisions," he just sets fire to the bush and leaves it to burn itself out. Where the forest is virgin, it is often necessary to burn it in order to get rid of the tangled growth of underwood and the teeming multitudes of insect life. But the Chinaman who burnt down his house to roast his pig was almost an economist in comparison with the negro, who sometimes burns down a whole mountain side in order to clear half an acre. We often see something of the same kind in this country. On commons, moors, and open wastes fires are almost a regular occurrence at certain seasons of the year. Sometimes they are due to a mere accident such as our correspondent mentions—to the careless throwing down of a match or a cigarette, even to the rubbing together of dry twigs in a breeze, sometimes, indeed, to the broken end of a bottle acting as a burning-glass. But far more often they are due to wantonness or love of mischief, and not seldom to deliberate purpose and design. Whatever the cause, the effect is nearly always disastrous, because the fire, once kindled, is seldom extinguished before it has wrought widespread and often irreparable mischief. Such, according to our correspondent, is the present situation in Greece. The inexorable antagonism between man and the forest is displaying itself in an aggravated form. "Destructive forest fires are announced from every part of Greece—from the Morea, from Thessaly, from Ætolia, and from the slopes of Pindus." The predisposing cause appears to be an exceptionally hot and dry season, associated with unusually high winds. Add to these the carelessness and the greed of men, the jealousy of neighbouring communes, leading to wanton acts of incendiarism, and the utter indifference of the average peasant to the larger issue of forest preservation and economy, and we have explanation in abundance of the devastation which Greece will soon learn to rue.

Scientific forestry is the antidote which man has devised to remedy the evil of his natural antagonism to the forest. It is, however, seldom seriously cultivated until the evil has become acute. Often it is neglected until many of the consequences of neglecting it are irremediable. In Greece, according to our correspondent, it is neglected altogether. It is true that the protection of the national forests rests with the Greek Government. But our correspondent tells us that "a recent circular issued by the Minister of Finance, draws a lamentable picture of the incompetence and culpable indifference of the officials charged with this important duty. It appears that little is done to check the encroachments of the peasants and shepherds, to hinder the indiscriminate cutting of timber, or to prevent the conflagration." Hence Greece is rapidly losing the woodlands it still possesses, and sooner or later its scenery will be shorn of its beauty, its climate despoiled of its amenity. Spontaneous causes of fire, such as the rubbing together of dry twigs, or the conversion of a glass bottle into a lens, are rare. They are *veræ causæ*, no doubt, but in any case they are very occasional causes. It is the wanton or malicious firing of the woodlands that really does the mischief, and this can be repressed by proper preventive measures. No doubt it is difficult, as our correspondent says, to discover the incendiaries and bring them to account, but it is not beyond the resources of civilization, if the authorities are in earnest in the matter. In any case, if the Greek Government is supine, it is idle to expect better things from the peasants themselves. In spite of Virgil, agriculture is little compatible with a love of nature's beauties, and no peasant when he burns the forest ever thinks that he is ruining the land. *Flumina amem sylvasque inglorius*, cries Virgil in his poetic ardour to be a husbandman. He little thought, and the peasant never thinks, how close and organic is the relation between the river and the woodland. Even the Ilissus, the scene of Plato's immortal "Phædrus," is now only a chain of pools in summer. It must have been otherwise in Plato's time, and doubtless the reason is to be sought in the gradual loss of its forests by Greece.—*The Times*.

West Indian Timbers.

(By JOHN T. REA, F.S.I., *Surveyor, War Department.*)

THE following information has been compiled by the author as the result of four years' residence in the island of St. Lucia, West Indies. Much is original, but a great portion has necessarily been obtained from the brief and scattered notices of other writers. It is believed, however, that this is the only attempt that has been made to prepare anything like a full summary of West Indian timbers. Descriptions of a hundred of the more important varieties are here given, in the hope that many of these

valuable woods may receive fuller recognition of their value, by consumers in the United Kingdom, than has hitherto been the case. It is only from the large forests of British Honduras and British Guiana, which are on the mainland, that copious supplies of cheap building timber can be obtained. There is, however, a plentiful supply of good stuff in the West Indian Islands, two-thirds of most of them being still in virgin bush and forest. For example, the Layou and Sara Flats, or Crown Lands of Dominica, have an area of 40 square miles, and contain a mine of wealth in timber; while in Trinidad there are at least 300,000 acres of forest land. Combined, the West Indies represent an area of 100,000 square miles. There are some very large trees, but, generally speaking, they are of moderate size, and only comparatively small scantlings can be cut. Some of the woods are useful for building and engineering works, but they are suitable principally for furniture, panelling, cabinet, and other fancy work. The immense variety of small articles, such as knife-handles, knobs, buttons, etc., which are now manufactured from choice grained woods, opens a ready market to many West Indian timbers, the beauty and appearance of which cannot be surpassed. Gum and resin-yielding trees abound; and commercially valuable fibres may be stripped from quite a number of them. The barks, leaves, and berries of others furnish well-known drugs, dyes, and spices. The economic uses are therefore very great, so that these colonies afford a fair field to the enterprising capitalist. Owing to the fact that all the best timber is in the inland forests, with few convenient rivers for floating it down, and also owing to the defective character of these means of communication, and the absence of sawmills and machinery for their treatment, the native woods have until lately been only available in small quantities. Circular and other rapid saws have recently been added to the plant of most of the Public Works yards, so that some of these disabilities are being remedied.

The subject of Forest Conservancy has been considered many times by governors, colonial engineers, surveyors, wardens, botanists, and by officers of the Crown Lands, but a continuous definite policy does not appear to have been ever decided upon. This is to be regretted, as much destruction has occurred through fires, chiefly caused by wanton squatters. A forest of West Indian cedar would at the present time be a source of wealth to any man who was lucky enough to possess it. The same may be said of mahogany and other native woods. Yet it is but on rare occasions that trees are planted, and then only in twos and threes in some garden. This is because the owner of the land fears he shall never see the benefit, on account of the length of time they take to grow. Such reasoning, however, is very short-sighted. A good plantation of cedar or mahogany will, within ten years, enhance the value of lands by 50 or 60 per cent., if tended with a modicum of care, and the State should take steps to give practical illustra-

tion of this on lands suited to the purpose, at the hands of properly instructed officers.

SEASONING.—Timber may be cut down at any time of the year, but it is preferable to do so during the dry season, and before the wet months commence (on the same principle as felling at home in the winter, when the sap is down), as the trees then become extra sappy with the absorption of the moisture. Native wood-cutters have an idea—which may be laughed at, but is believed locally to be right—that if the trees are not felled during certain phases of the moon, the timber is almost certain to be attacked by woodworms or borers, and they prefer, generally, the months of February and March for hewing. Practically this has been found to be correct, and the period between three days after new moon and three days before full moon is the time selected.

A very important precaution adopted in Australia, which might be applied to the woods of other colonies, is that of “ring-barking” (or severing the bark right round the stem down to the wood) all trees at least three months before they are felled, or, as it might be called, “killing them standing.” Indeed this practice is of high antiquity, and is mentioned by Vitruvius. The tree, in its perpendicular position, is thus more rapidly drained of its sap and juices when once the bark is cut through to the wood, so that they descend by the natural channels instead of slowly percolating into the woody tissues, and rotting the log when left in a horizontal position. The trees should be allowed to stand a twelvemonth after the operation, which not only increases the density and strength of the timber, but at the same time seasons it.

Trees should be squared and cut up immediately after felling, and the wood should not be worked for six months, or even a year, during which period it ought to be stacked, and well covered in sheds, with a free circulation of air round the several pieces, otherwise it will warp and twist when used. Owing to the readiness with which it is attacked by ants, all wood in store, especially unwrought spars, should be stowed away so as to admit of easy and frequent inspection. This liability to attack is greatly increased if the bark be left on.

ATTACKS OF ANTS, WORMS, ETC.—With the exception of some of the bitter and hard woods, most of the timber is liable to the attacks of “white ants,” commonly called wood-lice, and this is especially the case with white pine and white oak. Mr. J. H. Hart, F.L.S., Superintendent of the Royal Botanic Gardens, Trinidad, declares that these insects *do not attack sound wood*, but only that which has first been permeated by the mycelium of a fungus, which has probably found entrance to its tissues at some point of injury, as, for example, at any spot which is rendered damp by leakage from the roof or other cause. The insects thus follow the attack of the fungi, and as they eat away the heart,

an apparently healthy piece ultimately becomes nothing but a mere shell, which suddenly collapses without warning. The writer has known beams and legs of tables insidiously hollowed out in this manner, there being no visible indication outside. The true ants which attack timber march in columns during daylight, and not in covered runs as do the termites. The former, as a rule, maintain their nest, made of clay, in some neighbouring tree, in a position sheltered from rain, and often travel to a considerable distance from the place where they are working at the destruction of timber.

To escape their depredations the builder must, therefore, first of all prevent the attack of the fungus by insisting upon conditions ensuring perfect ventilation and dryness, which are well known to be antagonistic to the growth of this form of vegetable life. One cure is said to be a treatment with calomel, or with molasses and arsenic, but the pests often reappear. Kerosene is effective while its smell remains. Creosoting with bone oil is said to be the best preservative against white ants, but on account of its odour it is only adapted for out-door work, and it is difficult to apply to dense tropical timbers. The appearance of the ants should be watched for their "traces," or little mud tunnels, followed up, and the whole nest destroyed. The only permanent antidote is to employ some of the bitter and hard woods which these insects avoid, such as quassia, or bitter ash. Notwithstanding the supposed immunity of greenheart, it is found in St. Lucia to be subject, in salt water, to attacks from worms, probably the *teredo navalis*, or ship-worm.

CLASSIFICATION.—It is very difficult to determine the classification of West Indian trees, as the names of perhaps the same tree vary in different islands, while the variations of patois titles also lead to much confusion. In many instances it is also difficult to substitute English equivalents for the patois, or corrupt French or Spanish names, while the scientific titles of other trees have not yet been determined. It is thought, however, that the following nomenclature will be generally accepted.

PRINCIPAL TIMBERS OF THE WEST INDIES.

1. ACOMA (*Mimusops*, Sp.). Also called Mastic. Found in most of the islands. A large timber tree, with wood hard, dense, and durable, and of a light brownish colour. Excellent for using in the ground, as in posts, where it will last without protection for years. It is likewise fit for cabinet work, and house building generally. Native workmen sometimes make their planes of acoma. Weight, 66lb. per foot cube.
2. ADEGON (*Ardisia*, Sp.). Grows in Dominica. A large tree, 4 or 5 feet in diameter, employed for all purposes, such as boards, planks, mill work, house work, shipbuilding, shingles, etc. Lasts well in water.

3. ALMOND, or Amandier (*Terminalia catappa*). Found in most of the islands. From its appearance the wood is styled "native mahogany" in St. Lucia, although no real mahogany grows in that island. It possesses similar characteristics, attains a large size, and is used for furniture and house work. There are two sorts of the wood, light brown and dark brown, the latter being reddish and streaky. Weight, 56 lb. per foot cube. There is another kind of wood spoken of by the natives as Mahault-Garnier, and likewise known by them as "mahogany."

4. ANGELIN (*Andira inermis*). Grows in St. Lucia and several other islands. A large tree, 40 to 50 feet high, and 3 to 5 feet in diameter, producing fine timber when full grown. Sometimes referred to as the Cabbage tree. There are two kinds, red and white. It is a strong hardy wood, lasting well in water, and is therefore suitable for piles, bridges, etc., as well as for framing houses, mill rollers and naves of wheels. It has been used for treads of steps in St. Lucia. The grain is brown and streaky, and very like cocoanut. Weight, 58 lb. per foot cube. The bark, known in England as "wormbark" or "bastard cabbage bark," is a narcotic drug.

5. ANNATTO, or Roncon (*Bixa orellana*). Found in most of the islands. A low shrubby tree, rising to 12 feet high on the banks of rivers, from the prepared seeds of which the celebrated reddish-yellow annatto dye is extracted. The seeds and leaves are likewise employed in medicine as an astringent and febrifuge. The stem has fibres, which in Jamaica are converted into ropes. The wood is soft, and the friction of two pieces will produce fire.

6. AQUATAPANA (*Watercaine*). Found in Trinidad. The tree is from 18 inches to 3 feet in diameter, and of very straight growth. The wood is curious, and susceptible of a high polish. It is useful and durable, and said to last longest under ground. Its local value is about £8 per ton.

7. ARAMATA. Grows in the Itoori-hisi creek, Essequibo river, British Guiana. This is a comparatively common tree throughout the colony, and flourishes on sandy soil. The wood is hard and dark-coloured, being used for boat-building, house-framing, and sometimes for cabinet work. Its average height is about 80 feet, and it can be had to square 12 inches, free of sap. A decoction of the bark is used by the Indians to wash their dogs to destroy vermin.

8. ARRISOUROO, from the upper Essequibo river, British Guiana, growing plentifully in low situations near the river. The average height is 80 feet and it will square 14 inches, free of sap. The wood is of a dark yellow colour, and has a very bitter taste. It lasts long when exposed to the weather, and is not attacked

by worms; for these reasons it is well adapted for planking vessels, etc. A decoction of the bark is used for dressing ulcers, and the sap as a remedy for ringworm.

9. *BALATA* (*Mimusop globosa*). Named Bullet tree, or Burneh, in British Guiana; also called Bully wood. This is a lofty tree found in most of the islands, and generally on hills in the forests. The trunk sometimes attains a diameter of 7 feet, and squared logs can be obtained 46 feet long. It grows plentifully in Berbice, where it may be found 5 feet in diameter and 100 feet high, yielding logs 42 inches square, free of sap. There are three varieties of balata—red, white and black; all three very good, but the red is the best. The wood is dense, hard, heavy, having a sour smell when freshly cut; it is most durable when free of sap, and is suitable for most outside work, harbour work, and all carpentry and joinery, but it warps much in seasoning and cracks when exposed to the sun. It is used for telegraph posts, for mill rollers and beams in old sugar factories, and for skittle alley platforms, field work, bridging, spars, etc.: it also produces good shingles, and native workmen frequently make their planes of it. During the time that windmills were used in British Guiana, the bullet trees was considered to produce the best wood for the arms of the mill. Wood-ants will not attack balata except the bark and sap, and when stored, the former should be stripped off as a safeguard. Weight 70 lb. per foot cube. Crushing strength, 4.77 tons per square inch. Modulus of rupture (tested by breaking spars of 6-inch diameter) = 16,000 lb. per square inch. There is good and bad balata wood (as with other timbers,) and natives will endeavour to impose inferior stuff, which is also the case with other woods. "Balata chien," which resembles the black balata and is somewhat harder, is totally worthless. The balata is one of the most important trees of the West Indies, and in Dutch Guiana special laws have been made to control the industry. It yields the "gum-balata," which is intermediate in its properties between caoutchouc and gutta-percha. Its fruit is very sweet, and tastes like the sapodilla, being about the size of a large English cherry. Many of the trees are cut down while the fruit is ripe. From the seeds oil can be extracted. The bark of the bullet tree is used medicinally by the Indians, and occasionally as an emetic. The value of the wood on the spot is about £10 per ton.

10. *BAMBOO*, which prefers wet lands, grows in clumps of clustering hollow stems, with rings, the bright green colour of which changes to yellow after cutting down. There are two sorts, male and female. The male bamboo (*Dendrocalamus strictus*) has almost a solid stem, with only a very small central perforation, and is much rarer than the female or common bamboo. It is practically a cane, and may be applied to the same services. The fibre can be made into paper, and into a valuable packing

for the wheel boxes of railway carriages. The female bamboo (*Bambusa vulgaris*) has a hollow stem, and reaches to three or four times the size of the male, with a hole 4 to 6 inches diameter. The height is often as much as 30 feet. It is useful for light framework, and for planting on earth slopes to prevent slipping; and is also serviceable for subsoil drainage, if the internal divisions are pierced. Split bamboos are used on native huts for eavesgutters, and have also been set in frames and converted into shutter screens for verandahs.

11. BARTABALLI (*Achras mammosa*), from the Moraballi creek, Essequibo river, British Guiana. This tree grows on sandy and clay soils, and is found plentifully up the Essequibo and Demerara rivers; it averages a height of 90 feet, and can be had to square 20 inches, free of sap. The wood is close grained, light, of a pale brown colour, and is useful for making articles of furniture, and for partition boards, doors, etc. The tree produces a milky juice somewhat similar to "gum-balata," but of a sticky nature. The fruit is good-eating and is eagerly sought for by the Indians during its season (about April) when, with characteristic carelessness, the trees are cut down in large numbers merely for the sake of obtaining it. Weight, about 56 lb. per foot cube.

12. BULLET OR BULLY TREE (*Dipholis Montana*), is a native of Jamaica and Cuba; it grows to 4 feet diameter, and the wood is hard, close-grained, and heavy. It is largely employed in general construction, is durable and much used for sawing into boards, planks, scantlings, and shingles. There are several varieties, not all belonging to one species. The term bullet or bully trees seems to be a vulgar classification for any hard, heavy, or close grained timber.

13. BREAD FRUIT (*Artocarpus incisa*), which is found in most of the islands, is a timber tree some 20 feet high with beautiful large leaves. It has been imported into the West Indies from the South Sea Islands. The wood is pretty when polished, and suited for furniture, boards and internal house work. The fruit is called the "daily bread" of the negro, and is a staple article of food, being usually cut into pieces and roasted or baked. It yields a good starch, too, for ordinary purposes. Another kind of bread-fruit tree, with great leaves, is found in the higher forests. The wood is slate-coloured, with a straight grain, and splits easily; hence it is excellent for making laths.

14. BREADNUT (*Brosimum Alicastrum*, Sw.) This tree, a native of Jamaica and other islands, is about 80 feet high, generally straight, with the diameter of about 2 feet, and grows abundantly in the interior. The timber is good, and makes capital boards, which take a high polish and furnish beautiful flooring. The heartwood has a rich brown colour, with very durable qualities, and is excellently fitted for ornamental work of all

kinds. The nuts and leaves form a valuable fodder, readily eaten by horses and cattle.

15. CACONIES (*Ormosia dysacarpa*). Found in Dominica. A large tree, 3 or 4 feet diameter, common in the forest, the wood being useful for all kinds of house work, inside and out, rafters, posts, etc., and for any other purpose for which lumber is employed. It is called the "head" or "necklace" tree, on account of the seeds being used for personal adornment. These are very hard and roundish, beautifully polished, and of a bright scarlet colour with a jet black spot at one end. They are considered of value in Europe, and they might be made an article of export.

16. CALABASH (*Crescentia Cujele*). Found in most of the islands. The tree is comparatively small, about 30 feet high and 18 inches diameter, pretty growing, with peculiarly arranged small leaves clustering close to the horizontal branches. The wood is hard, tough, and pliant, and, being almost black, takes a fine polish. Being of crooked growth it is only employed for small work, such as handles of tools, carriages, cattle yokes, etc., and in British Guiana for bullet-proof stockades. Weight, 54lb. per foot cube. Crushing strength 1.42 tons per square inch. The shell of the fruit is converted by the peasants into cups and water utensils. The expressed juice of the pulp is a purgative. Value about £5 per ton.

17. CARAPA (*Carapa Guianensis*). Found in Trinidad and British Guiana. A very abundant and useful wood, bearing a considerable resemblance to cedar. It is strong and coarse, and is much used for house building and furniture. The tree is from 2 to 3 feet diameter, and will reach 120 feet in height; value on the spot £8 per ton. There are two kinds, the white and the red. Carapa, or caraba, is also known as crabwood. The seeds yield the well-known "crab-oil," and the bark is used for tanning.

18. CASHEW (*Anacardium occidentale*) grows in most of the islands. A short and spreading tree 30 to 40 feet high, and about a foot in diameter. The wood is red, moderately hard, and close-grained. Weight 61 lb. per foot cube. Crushing strength, 3.76 tons per square inch. Produces a black juice used for staining floors, etc., as a preservative from the attacks of ants, and in book-binding to protect from moths; it likewise makes an excellent marking ink. The juice from the bark is astringent, and is used as a flux for soldering metals. A gum is obtained from the tree similar in its properties to gum arabic, and a very intoxicating drink can be made from the buds and leaves. The kernels yield a valuable and nutritious oil, and are a great delicacy when roasted.

19. COCCUS, or West Indian Ebony (*Brya ebenus*), a native of Jamaica and Cuba. A small tree, 15 to 20 feet high, with

drooping branches, and rarely found with a diameter over 8 inches. It has a hard deep-coloured heartwood, close-grained, and is exported. Used for handles of tools, etc.

20. COCOANUT (*Cocos nucifera*). These palms are greedy of salt, and essentially belong to the sea-shore, although they will thrive at a considerable distance inland. The tree is slender, without branches, and from 40 to 80 feet high, ending in a plume of fronds, the stem being usually wavy from the effects of the wind. The wood when matured is of a most peculiar texture, consisting in cross section of a multitude of dark brown specks in a lighter ground, and of a streaky appearance longitudinally. It is strong and heavy, and exceedingly pretty when polished, but most hard to work, although when freshly cut it is spongy. When well seasoned it will last for a long time underground. Weight, 70 lb. per foot cube. It is known in commerce as Porcupine wood (from its speckled colour resembling porcupine quills), and is adapted for walking sticks, fancy articles, frames, furniture, rafters, and for inlaying, but the tree is generally too valuable to cut down for such purposes, or for timber. The wood in the green state is very porous and spongy, having a great degree of resistance to rifle shot. In the native wars of Samoa it was much employed in the building of defensive works. Coconut oil is pressed from the dried kernel of the nut, and the strong fibrous husk, called coir-fibre, which covers it, is much used for matting and cordage. A dye can be extracted from every part of the plant, producing a dirty brown colour. It is the most valued of the palms because of its numerous economic properties. Sunlight and exposure to regular breezes are most beneficial to the coconut tree, and its cultivation is a very profitable industry.

21. CONTREVENT (*Lucuma multiflora*). Grows in Trinidad, St. Lucia, etc. This is a noble timber tree, producing an excellent hard wood for mill rollers, frames, furniture, and house building.

22. CORKWOOD, West Indian (*Ochroma lagopus*). Found in Jamaica, Trinidad, St. Lucia, etc. A tree which grows to two feet diameter, and 20 to 40 feet high, and is only to be found in the open or cleared land. The wood is white, with a hole in the heart, and is softer than ordinary cork, for which it is utilized as a substitute for stopping bottles, by fishermen to float their nets, and for other purposes where light wood is required. The bark gives a useful fibre for rope-making. A soft cotton or down comes from the seed envelopes, and is employed for stuffing pillows, etc. It is termed *Down tree* in Jamaica.

23. DETERMA, from the Moraballi creek, Essequibo river, British Guiana. Grows best on clayey gravelly soil, and is more plentiful in the Moraballi creek than in any other part of the colony below the rapids. The average height is 100 feet, and it can be had to square up to 30 inches. The wood is of a colour

resembling cedar, and is used for planking boats, constructing railway carriages and for many other purposes requiring a light and strong wood. Determa is also employed for the masts and spars of vessels, which are procurable from 70 to 90 feet long, and 14 inches diameter at the smallest end. Logs have been obtained 42 inches square.

24. Dogwood (*Piscidia erythrina*) occurs in British Honduras, Jamaica, St. Lucia, etc. A straight tree, growing to a height of 100 feet and 30 inches diameter. The wood is hard; it is employed for rollers of native sugar mills, and is converted into charcoal for gunpowder. It is tough and elastic, and used in cart building for the body and wheels. The root bark is employed in the United States as a narcotic, and locally to stupefy fish. A variety of this wood, which is slightly harder, is known by the Indian name of *Javin*.

25. DUKALA-BALLI, from the Moraballi creek, Essequibo river, British Guiana. This is a rare tree and grows in clay and sandy soil. It attains a large size, the average height being 120 feet, and it will square, free of sap, 20 inches. The wood is of a deep red colour, heavy and close grained, and is used for making articles of furniture, bedstead posts, etc. It takes a fine polish, and is durable.

26. DUKURIA, from the same place, is plentiful throughout the colony and grows in dry soils. The average height is 90 feet, and it will square 16 inches, free of sap. It is used for house-framing and many other purposes, and is a very serviceable wood. There are two kinds of Dukuria, fine and large leaved.

27. FLAMBEAU, or Torch-wood (*Tecoma stans*), found in the majority of the islands, is a small tree, but the wood is extremely durable, hard and heavy, with the annual rings distinctly marked in cross section. It is obtainable in lengths of 20 feet and over, and 7 inches at butt. Excellent for posts and outside work, such as fences, for which it is commonly employed on War Department lands. There are two sorts—black and white. Drugs are procured from the wood, which blazes brightly when burnt; hence it is used for flambeaux, or torches.

28. FOGLEKOP, from the Itoori-bisci creek, Essequibo river. Grows in sandy soil, and is a light coloured close-grained wood of little weight. It is plentiful on the Essequibo and Pomeroon rivers. It furnishes boards used for indoor work, doors, partitions, etc. The average height is 70 feet, and it will square 12 inches. Foglekop bears a small eatable fruit, the seeds of which contain oil.

29. FUKADIE, from the Moraballi creek, Essequibo river. The tree grows on sandy soil to about 80 feet, and it can be had to square 16 inches free of sap. It is used for house framing,

and is durable for indoor work. Fukadie is very plentiful on the Itoori-hisci creek, and generally in Essequibo.

30. FUSTIC (*Chlorophora tinctoria*). Found in the majority of the islands. Grows rapidly, forming a fair-sized tree in five or six years, and living in almost any soil. The wood is close grained, hard, tough, and of a bright and extremely pretty canary yellow colour. It produces handsome cabinet work, panels, etc., and is the finest for hubs of wheels, but is chiefly exported as a yellow dye-wood, especially from Jamaica. Weight, 42lb. per foot cube. Eight tons per annum have been exported from St. Lucia to the United Kingdom. About 100 tons are exported annually from British Honduras. This tree (called *bois d'orange* by the natives in some of the islands) must not be confounded with the orange fruit tree, though fustic also possesses a small sweet fruit.

31. GALBA (*Calophyllum calaba*). Found in Jamaica, Trinidad, St. Lucia, etc. An evergreen, which makes fine hedges because of its rapid and vigorous growth; height 50 to 60 feet, and 2 to 4 feet diameter. The wood is of a white to reddish colour, hard and durable, and texture often pretty. It is good for constructional purposes, shipbuilding, and heavy machine work; for posts, furniture and felloes of wheels. Bears exposure to moisture and lasts well in water. Weight, 46 lb. per foot cube. Value on the spot £5 per ton. The seeds yield an oil for lamps, and drugs are prepared from the resinous juice. Galba is also known as crabwood.

32. GRANADILLA.—Grows in British Honduras, the height being about 80 feet, and diameter 2 feet. It rises 50 feet without a limb, and is, therefore, a conspicuous forest tree. Produces a hard, dark-red wood, with a beautiful fine grain, and easy to work. Being abundant it is used for furniture and house decoration. This tree must not be confounded with the vine Granadilla, bearing a luscious fruit.

33. GREENHEART, or Bibiru (*Nectandra Rodiei*), comes principally from British Guiana, but it also grows in Trinidad, Jamaica, and Dominica. The tree is 60 to 100 feet high, and up to 2 feet diameter, yielding barks 50 to 60 feet long and 18 to 24 inches square without a knot. It grows in clay soil near the rivers and creeks, especially the Moraballi creek, Essequibo river. There are three varieties of greenheart, yellow, black, and mainop, all most serviceable and durable woods if cut when mature. It should be specified to be from logs of not less than two feet in diameter, as trees of less thickness are young and sappy, and such wood is liable to shrink and split. The timber comes into the market roughly hewn, much bark being left on the angles, and the ends of the butts are not cut off square. The section is of fine grain, and very full of fine pores, like that of a cane. The annual

rings are rarely distinct. The heartwood is dark green or chestnut coloured, the central portion being deep brownish-purple or almost black; the sapwood is green, and often not recognizable from the heart, while the general appearance of the wood is a greenish-yellow colour. Greenheart is close, hard, durable, and said to be the strongest timber in use. It is apt to split and splinter, and therefore requires great care in working, but it is tough and elastic, and a small beam, 3 ft. by 1 in. by 1 in., has withstood a central load of 10 cwt. without breaking. Breaking weight, 1424 lb.; crushing weight, 12,000 lb. Weight, 60 lb. per foot cube. Greenheart is one of the eight first-class woods at Lloyd's, and is unsurpassed by any other in British Guiana. It is used for marine works, such as piles, piers, jetties, dock gates, and for shipbuilding in kelsons, knees, planking vessels, etc. It contains an essential oil, and many authorities state that on this account it resists the attacks of the *teredo navalis*, or ship-worm. This, however, is doubtful, and it has been found to be much eaten away by molluscs in sea-water at St. Lucia, when used for piles. But it appears that in any case worms will only penetrate the sapwood. The presence of the oil causes the timber to burn freely, so that in Demerara it is known as "torchwood." From the bark and seeds "bibirine" is extracted, and the Indians use the seeds medicinally in cases of diarrhoea, and sometimes for food, when ground and mixed with other meal. Because of the great demand for greenheart and the want of legal restriction to prevent the cutting of the young trees by wood-cutters and charcoal burners, it is becoming extremely difficult to procure good timber, and its preservation is worthy of the attention of the Colonial Legislature.

34. GRI-GRI (*Martinezia caryotæfolia*). Found in Trinidad, Jamaica, St. Lucia, etc. A sort of small cane palm rising 20 feet high, with rings on the trunk. The wood is streaky and almost black: it furnishes a beautiful veneer, and makes handsome walking sticks. A fibre is produced from this tree which is said to be even stronger than that from the gru-gru. The cabbage is very sweet, and may be eaten raw.

35. GRU-GRU, Grou-grou, or Groo-groo (*Acrocomia lasiocarpa*). Also called the Macaw palm, or Great Macaw tree. Found in Trinidad, Jamaica, St. Lucia, etc. It is bigger than the gri-gri, with trunk 30 to 45 feet high, covered with black spines, and supporting a solid head of feathery leaves. The outer part of the trunk is black as ebony, hard, heavy, and durable, and susceptible of a high polish. The wood possesses the characteristic of never bending, warping, or curling longitudinally. It furnishes a beautiful veneer, and might be used for furniture and cabinet work. It is sometimes run into mouldings, its dark colour forming a fine set-off to a panel of pine, and it likewise makes handsome walking sticks. A fibre of remarkable fineness and

strength is prepared from the leaves. Both the gru-gru and gri-gri palms produce seeds which contain a large proportion of sweet palatable oil which in St. Vincent is extracted and used for cooking purposes. This oil is also used for external application to ease pain.

36. **HACKIA** (*Siderodendron triflorum*), from British Guiana. The tree averages 65 feet in height, and will square 12 or 14 inches free of sap. It grows plentifully in some localities on dry sandy soil, and during the time it is in flower, in November, it is one of the most beautiful of the forest trees. The wood is exceedingly hard, close-grained, heavy and of a brown colour. It is valuable for making cogs and shafts, but it is almost too hard for any other purpose.

37. **HIAWA-BALLI** (*Omphalobium Lambertii*), from the Itoorihisci creek, Essequibo river. The average height is 90 feet, and it will square, free of sap, 12 inches. Hiawa-balli grows in sand and rocky soil, and often attains a large size. It is a rare tree, and the wood is in great request for cabinet work, being of great beauty and easily worked. It has a sticky gum.

38. **HOUBOO-BALLI**, from the same locality, where it grows plentifully. The tree reaches an average height of 100 feet and will square 20 inches free of sap. The wood is of a light brown colour, variegated with the black and brown veins; it takes a fine polish and is useful for making articles of furniture and cabinet work of any description. Under water it lasts a long time, and on the bottom of a boat will outlast almost any other wood. The bark contains a sticky gum.

39. **IRON-WOOD** (*Laplacea hæmatoxylon*). Every timber region has its own ironwood. This particular variety is found in British Honduras, Jamaica, St. Lucia, etc. It is also termed blood wood from its red colour. The tree is about 30 feet high, and a foot in diameter. It is the hardest timber in the West Indies, and generally found not far from the sea, and is of a deep reddish colour, heavy, with dense grain, and will not decay in wet or dry soil. It has much the same qualities as boxwood, and is useful for the same purposes, and for posts. Iron-wood has no heart, so it makes little difference whether it is cut young or old. A good dye is obtained from the rich red wood.

40. **IRRIARIADAN**, from the Moraballi creek, Essequibo river. The average height is 80 feet, and it can be had to square 10 inches, free of sap. It grows plentifully on high sandy soil, but is little known. The wood is fine, of a dark brown colour, and is suitable for cabinet work, partition boards, staves, and many other purposes.

41. **ITIKIBOURA-BALLI**, from the same place. It grows on clay soil, and on the islands in the rapids of the Essequibo. The

tree is comparatively rare below the rapids, and does not attain to an average height of more than 70 feet. The sapwood is white, and its junction with the heart, which is of a deep brown or almost black, is sharply defined. The timber can be had to square up to 15 inches, free of sap, and is employed for making articles of furniture and walking sticks. Itikiboura-balli is one of the heaviest and closest grained wood in British Guiana.

42. JACK FRUIT (*Artocarpus integrifolia*). Found in Jamaica and Trinidad. The wood is yellow, hard, takes an excellent polish, is beautifully marked, and is one of the handsomest for furniture. Weight, 40 lb. per foot cube. It yields, on boiling, a yellow dye. The bark produces a gum which is used as a cement and as bird-lime; also a fibre.

43. KABUKALLI, from the Moraballi creek, Essequibo river, British Guiana. This tree is plentiful all over the colony, and thrives best in loose sandy soil. It is one of the tallest forest trees, and grows very straight; its average height is 120 feet, and it can be had to square 30 inches, free of sap. Kabukalli is used in boat building, and for timber is little inferior to Mora. It has a very unpleasant smell, and is disliked by worms. Weight, 70 lb. per foot cube. The Indians, living in the wet savannahs, or where the rivers are free of bush to form a shade, prefer canoes made of this wood to any other, as they will not split from exposure to the sun. A gelatinous substance forms on the stump after cutting down a kabukalli tree; it has a disagreeable smell, and never hardens.

44. KAKARALLI (*Lecythis ollaria*), from the Itoori-bisci creek, Essequibo river. There are two kinds common throughout the county of Essequibo, and known as the white and the black kakaralli. These woods are close grained and tough, and of a light brown colour; they are used for house framing, building wharves, etc. It is said that barnacles will not eat or injure kakaralli. These trees grow tall and straight, but are too heavy to convert into spars. The average height is 80 feet, and they will square 16 inches, free of sap. The inner bark of the white kakaralli is used by the Indians as a substitute for, and in preference to, paper for making their cigarettes, and is named "ouina."

45. KAMARAKATA, from the upper Essequibo river. The tree is comparatively short, not averaging more than 50 feet in height, but has a large trunk. It can be had to square 22 inches, free of sap, of which there is very little. It grows in Mahaicony, and on the Essequibo in low places near the river (often hanging over the water), and on the islands in and above the rapids. The wood is dark brown, close grained, heavy, and of a bitter taste, and resembles Hackia. It is very lasting, and is used for boat timbers, for which purpose it answers well.

46. KARAHURA, from the Moraballi creek, Essequibo river. It grows generally throughout the colony in dry places; its average height is 80 feet, and it can be had to square 30 inches. Karahura is one of the lightest of colonial woods, and is only fit for partition boards and other indoor work of a similar nature. The Indians use it for making canoes.

47. KAUTA-BALLI, from the same district. There are two or three varieties of this tree, distinguished by the size of their leaves. Kanta-balli grows to its largest size on clay soil mixed with gravelly ironstone. It is abundant on hilly land, and attains to an average height of 80 feet, and can be had to square 14 inches. The wood is useful for house framing, is hard and has a close straight grain. The fruit is not edible; the bark, made into charcoal and ground to powder, is used by the Indian women to mix with the clay, of which their pots, goglets, and other earthenware vessels are made.

48. KERITEE, or Kretti, from the Aroua-pia-kooroo creek, Pomeroon river, British Guiana. The tree averages 80 feet in height, and will square 20 inches, being plentiful in some localities. The wood has a strong aromatic scent, is light, and in colour and appearance resembles satinwood. It is useful for partitions, and the upper planking of boats.

49. KOOROO-BALLI, or Trysil, from the Moraballi creek, where it grows plentifully. The average height of the trees in the forest on the upper parts of the Essequibo river is 60 feet. On the coast lands and in the swamps at the back of estates, where large quantities are cut for firewood, it does not grow so large. The wood is dark, close grained, and suitable for making furniture; it can be had to square 10 inches free from sap. The bark is employed by the Indians in cases of dysentery.

50. KUMARA, or Tonkin bean (*Dipterix odorata*), from the Itoori-bisci creek, Essequibo river. The tree grows plentifully in some localities, especially above and on the islands in the rapids of the Essequibo river. The average height is 90 feet, and it will square 22 inches. Kumara is a close-grained, heavy, brown coloured wood, exceedingly tough and durable, and is useful for cogs, shafts, and any other purpose where a strong wood capable of resisting great pressure is desired. This tree yields the Tonkin beans, well known in the colony; they are used by the Indians to perfume their hair-oil, and when put among clothing are supposed to keep away moths and other insects. An oil can be extracted from the beans.

51. KURAHARA, from the same place. The tree grows in sandy soil and on the edges of swamps; it is very straight, with dark green leaves. The average height is 90 feet, and it will square 20 inches free of sap. The wood is red, light, and like

cedar ; it is employed for making canoes, planking boats, and for spars. It has a resinous gum.

52. KURAROO, or Bat-seed, from the same place. It is a tree common throughout British Guiana, and may be seen growing in Georgetown, where it is known as Wild Olive. It does not grow very tall, but the diameter of the trunk is great in proportion to its height, which averages 60 feet, and it can be had to square 3 to 4 feet, in short lengths. The wood is hard but not very durable, and is little used ; it takes a fine polish and would be suitable for furniture.

53. LANCEWOOD. There are two varieties—Black Lancewood (*Bocagea virgata*), and White Lancewood (*Bocagea laurifolia*). Found in Cuba, Hayti, Jamaica, etc. A tall slim tree, growing straight to 30 feet high, and 12 inches diameter. The wood possesses great elasticity, and is much used in carriage building, for which purpose it is exported. Jamaica spars fetch higher prices in the home market than similar wood from other places. The export from Jamaica for twenty years has been valued at £31,275.

54. LAURIERS, or Laurel trees. Found in nearly all the islands. There are more than a dozen varieties, known by such names as Laurier Canelle, Laurier Cypres, Laurier Fourmis, Laurier Marbré, Laurier Piant, Laurier Sifrene, Laurier Zabel, etc. Of these the most important is Laurier Canelle, or Cinnamon Laurel. This tree is 30 to 35 feet high, and 2 to 3 feet diameter. The wood is of a bright brownish colour, with a strong agreeable smell. It is plentiful, and used for telegraph posts, and is suitable for most purposes for which pitch pine is employed. Weight, 30lb. per foot cube. Value about £7 per ton.

Laurier Piant, or Puant or Smelling Laurel, is also of considerable utility. The tree is likewise 30 to 35 feet high, and 2 to 3 feet diameter. The wood has a pleasant smell somewhat similar to cedar, and is said to be free from the attacks of wood-ants. Withstands the weather, but warps, and lasts in the ground without any protection of charring or tarring. Employed for inside and outside work, boards, furniture, telegraph or other posts, etc., and general purposes. Weight, 52 lb. per foot cube.

55. LIGNUM VITÆ, or Gaiac (*Guaiacum officinale*). Found in Jamaica, Trinidad, St. Lucia, etc. A low tree up to 20 feet high, and 18 inches diameter. It is slow-growing, thriving best in well-drained and dry districts, and stands drought better than many trees. The heartwood is of a dark greenish-brown colour, owing to the deposition of guaiacum resin ; the sapwood is nearly yellow. The wood is exceedingly dense, hard, heavy, and tough ; and will resist white ants. Weight, 76lb. per foot cube. It is

extremely useful for sheaves and blocks of pulleys, rulers, skittle balls, and other turnery purposes. Sometimes employed for machine bearings, where its qualities of hardness and durability render it preferable to metals. Crushing strength, 3·87 tons per square inch. The wood is used in the Bahamas for hinges and fastenings owing to the quick corrosion of iron. The *gum-resin guaiacum* is got from the tree and used as a medicine. This may be readily extracted from the wood by making an incision in the middle and then building a fire at both ends of a log. The bark is employed in Trinidad for preparing an *effervescing drink*, locally known as "mawbee." It is an official medicine of the British Pharmacopœia, where its uses are fully described.

56. LAZARD WOOD (*Vitex divaricata*, Sw.) Grows in Trinidad, St. Lucia, etc. Termed "Fiddle wood" in the former place. A large thick tree about 30 inches diameter and 25 feet high. The wood is strong, and one of the best and most lasting for house building. It is employed for inside and outside work, for shingles, posts in the ground, etc., and is durable in water. Weight, 75 lb. per foot cube.

57. LOCUST, or Simiri or Courbaril (*Hymenœa Courbaril*). Found in British Guiana, Jamaica, Trinidad, St. Lucia, etc. It is abundant, and grows best in white sandy soil, to as much as 5 feet diameter. There are two varieties of the tree—Simiri and K'wanarri—distinguished by the size of their bean-pods. The wood is of a reddish-brown colour, streaked, close-grained, extremely hard and tough. It resembles mahogany, but is much harder, and is liable to rot in the ground. Suitable for cabinet work and furniture, as it takes a fine polish. On account of its freedom from splitting or warping it is well adapted for mill timbers, cogs of wheels, and engine work, and makes good trenails for fastening planks. Crushing strength 5·17 tons per square inch. Weight, 59 lb. per foot cube. Value, £12 per ton. The Indians make wood-skin canoes from the bark. A fragrant amber-like resin, known as West Indian copal, or the Gum Animi of commerce, exudes from the stem. This gum is found in large quantities where a tree has rotted away, and small amounts may be procured by tapping. When this Gum Animi is dissolved in highly rectified spirits of wine it makes one of the finest varnishes known.

58. LOGWOOD, or Campêche wood (*Hæmatoxylon Campechianum*). Found throughout the West Indies, sometimes in dense thickets in marshy places. It is a small bush-like tree, not unlike English hawthorn, and generally acquires in about twenty years a diameter of a foot, with a total height of 20 feet. The heartwood is of a dark red colour, hard, and used for posts and cabinet work. It is, however, solely exported for dyeing and colouring wines, for which it is, perhaps, the most important of all dyestuffs. Logwood grows best, and produces finer heartwood, on

moist rich soils, where there is abundance of vegetable matter. It makes a strong and durable fence, but must be kept well pruned. There are several species of logwood, and the largest supplies come from Campêche and Yucatan. It is a powerful astringent. The yearly export from Jamaica varies from 22,000 to 115,000 tons. The quantity exported from St. Lucia in 1896 was 1,904 tons, valued at £4,284. The average annual export from Honduras is 17,000 tons.

59. MAHOGANY (*Swietenia mahoganii*). This celebrated timber comes chiefly from Central America as "Honduras" or "Bay" mahogany, or from the West Indies as "Spanish mahogany." The tree is of comparatively rapid growth, reaching maturity in about 200 years, the trunk exceeding 40 to 50 feet long and 6 to 12 feet diameter. It is very handsome, with enormous branches of solid timber; and, rather strangely, when it springs from low levels and rich soil the wood is most inferior, being poor in colour, soft and spongy, and consequently almost valueless. That, however, which has been grown without nourishment on high levels, save what it derives from the atmosphere, is hard, figured, densely close in texture, as well as rich and deep in colour, all qualifications which enhance its worth. It is also a curious fact that the tree does not seem to have any partiality, as it will flourish in low marshy ground, or in a deep alluvial soil, or even on rocks to all appearance barren of earth; in fact, wherever the seeds chance to drop. Its development is more rapid in the shade than in the open.

The following extract is from a well-known authority on timbers:—"Mahogany attains its greatest development and grows most abundantly between 10° N. lat. and the Tropic of Cancer, flourishing best on the higher crests of the hills, and preferring the lighter soils. It is found in abundance along the banks of the Usumacinta and other large rivers flowing into the Gulf of Mexico, as well as in the larger islands of the West Indies, such as Cuba, Jamaica, Bahamas, etc. British settlements for cutting and shipping the timber were established so long ago as 1638-40, and the right to the territory has been maintained by Great Britain, chiefly on account of the importance of this branch of industry. The cutting season usually commences about August. It is performed by gangs of men, numbering twenty to fifty, under the direction of a "captain," and accompanied by a "hunter," the duty of the latter being to search out suitable trees and guide the cutters to them. The felled trees of a season are scattered over a very wide area. All the larger ones are "squared" before being brought away on wheeled trucks along the forest roads made for the purpose. By March or April felling and trimming are completed; the dry season by that time permits the trucks to be wheeled to the river banks. A gang of forty men work six trucks, each requiring seven pair of oxen and two

drivers. Arrived at the river, the logs, duly marked, are thrown into the stream; the rainy season follows in May and June, and the rising current carries them seawards, guided by men following in canoes. A boom at the river mouth stops the timber, and enables each owner to identify his property. They are then made up into rafts, and taken to the wharves for a final trimming before shipment. The cutters often continue their operations far into the interior, and over the borders into Guatemala and Yucatan. Bahama mahogany grows abundantly on Andros island and others of the Bahama group. It is not exceeded in durability by any of the Bahama woods. It grows to a large size, but is generally cut to small dimensions, owing to the want of proper roads and other means of conveyance. It is principally used for bedsteads, etc., and the crooked trees and branches for ship timber. It is a fine, hard, close-grained, moderately heavy wood, of a fine rich colour, equal to that of Spanish mahogany, although probably too hard to be well adapted for the purposes to which the latter is usually applied. Honduras is best for strength and stiffness, while Spanish is most valued for ornamental purposes. Honduras mahogany is found in the country round the bay of Honduras, the trees being of considerable size. The average annual export is 3,000,000 feet. It is of a golden or red-brown colour, of various shades and degrees of brightness, often very much veined and mottled. The grain is coarser than that of Spanish, and the inferior qualities often contain grey specks. This timber is very durable when kept dry, but does not stand the weather well. It is seldom attacked by dry-rot, contains a resinous oil which prevents the attacks of insects, and is untouched by worms. It is strong, tough, and flexible when fresh, but becomes brittle when dry. It contains a very small proportion of sap, and is very free from shakes and other defects. The wood requires great care in seasoning, does not shrink or warp much, but if the seasoning process is carried on too rapidly it is liable to split into deep shakes externally. It holds glue very well, has a soft silky grain, contains no acids injurious to metal fastenings, and is less combustible than most timbers. It is generally of a plain straight grain and uniform colour, but is sometimes of wavy grain or figured. Its market forms are logs 2 to 4 feet square and 12 to 14 feet in length. Sometimes planks have been obtained 6 to 7 feet wide. Mahogany is known in the market as "plain," "veiny," "watered," "velvet-cowl," "bird's eye," and "festooned," according to the appearance of the vein formations. The weight varies from 35 to 53 lb. per foot cube. The cohesive force is 11,475 lb.

"Cuba or Spanish mahogany, from the island of Cuba, is distinguished from Honduras by a white, chalk-like substance which fills its pores. The wood is very sound, free from shakes, with a beautiful wavy grain or figure, and capable of receiving a high polish, when it is of a lighter yellow colour than Honduras.

It is used chiefly for furniture and ornamental purposes, and for shipbuilding. The logs as imported are 20 to 26 inches square and 10 feet long. The cohesive force is 7,560 lb., and the strength, stiffness, and toughness are respectively 67, 73, and 61 in Spanish, and 96, 93, and 99 in Honduras.

"Mexican mahogany shows the characteristics of Honduras. Some varieties of it are figured. It may be obtained in very large sizes, but the wood is spongy in the centre, coarse in quality, and very liable to star-shakes. It is imported in barks 15 to 36 inches square, and 18 to 30 feet long.

"St. Domingo mahogany and Nassau (Bahamas) mahogany are hard, heavy varieties, of a deep red colour, generally well veined or figured, and used for cabinet work. They are imported in very small logs, 6 to 12 inches square, and 3 to 10 feet long."

Jamaica mahogany is very fine, but the supply is almost, if not quite, exhausted, as the proprietors of estates, knowing that the tree must be about 200 years old before it is fit for felling, will not attempt to make plantations. In the great houses of West Indian estates there are many specimens of beams and rafters of mahogany, very old and in good condition; but at the present time it is very seldom employed, only those trees being cut which are found on waste pastures and in forest near cultivation, and they rarely give more than 10 inch planks. At no time has mahogany been largely exported from Jamaica, and recent trial shipments have been made at a loss. As a timber, the present stock is undoubtedly inferior to the Honduras varieties, having neither the ornamental grain and toughness of the one, nor the splendid dimensions acquired by the latter. With age it becomes of a good colour, and is always a handsome wood. Formerly the wood from Jamaica was specially reputed for its mottled grain.

The builder uses mahogany for handrails, furniture, joinery, cabinet and ornamental work, etc., but it is not fit for external work. It has been extensively employed in machinery for cotton mills, and has been largely used in shipbuilding, for beams, planking, and in many other ways as a substitute for oak, and found to answer exceedingly well. The wood is very durable in the dry, and not liable to worms. On the whole it is remarkably free from defects, converts easily and with little loss, and warps and twists less than any other wood. Taking everything into consideration mahogany is the most highly prized of all ornamental woods, and still holds the field.

60. MAMMEE APPLE (*Mammea Americana*). Found in

most of the islands. Also known as the South American Apricot. A tall handsome tree, about 80 feet high and 30 inches diameter, with vertically growing branches and dark green glossy leaves.

The wood is dense, hard, and heavy, and of a purple or reddish-brown colour. It is very durable, stands damp, and is good for rafters, boards, furniture, and cabinet-making. Weight, 60 lb. per foot cube. The bark is used as a medicine by the natives. A kind of wine is made from the shoots, and a scent from the wild flowers. The gum destroys the chigoes, or "jiggers," in the feet of the negroes.

61. MAMOORI-BALLI, from the Moraballi creek, Essequibo river, British Guiana. This tree is plentiful in Essequibo, and grows best in sandy soil. The average height is 70 feet, and it can be had to square 16 inches. The wood is tough and hard, and is suitable for house-framing and other work where it will not be exposed to the weather.

62. MANCHINEEL (*Hippomane Mancinella*). Grows in most islands, and generally found on sandy sea-shores. Sometimes styled the Manzanillo tree. The wood is of a tawny yellowish colour, beautifully variegated with brown and white, resembling maple and smelling like lavender. In some islands it is highly prized for furniture and ornaments, and in St. Lucia for studs, verandah floors, boarding, etc., as it is lasting for outside work. It is said there are seven different varieties in St. Lucia, and that some do not blister. Weight, 50 lb. per foot cube. The fruit has the appearance of an apple, but is a virulent poison; and the whole tree abounds with a milky white juice, which is also of an acrid quality. If a single drop of this juice touches the skin it causes a hot sensation, and raises a blister on the part, the antidote being the adjacent sea water. Blindness is likewise produced if the milk comes in contact with the eyes. Careful felling is required, and it is first necessary to kindle fires around the stem to thicken the noxious sap.

63. MANGO (*Mangifera Indica*). Found in every part of the West Indies, where it was introduced in the eighteenth century from the East Indies, and now grows spontaneously. It is a large umbrageous tree, very plentifully distributed, growing to 3 feet diameter, and 40 feet high. The leaves are pointed and thickly set. Gives a pretty red wood, of inferior quality, coarse, open grained, and soft. It is durable in dry, but decays if exposed to wet, and is much eaten by white ants. It has only a few special uses, but being plentiful and cheap it is frequently employed for common work; but not for beams, as it is liable to snap off short. Weight, 42 lb. per foot cube. Cohesive force, 7,700 lb. Breaking weight, 560 lb. The tree produces a delicious and popular fruit and the gum is used internally for diarrhœa and dysentery.

64. MANGROVE (*Rhizophora*). Found in the islands where there are swamps. There are three kinds—Black Mangrove (or "native oak"), Red Mangrove, and White Mangrove. The

black mangrove is only to be found in wet places, within two miles of the sea. It is called "native oak," which it resembles, but it is darker and harder. The usual size is 30 to 50 feet high, and 15 to 20 inches diameter, being the best wood for piles and poles, and even more durable than white cedar, but it is comparatively rare.

The red mangrove belongs to the same family, only instead of being dark brown it is red, and the leaves are more pointed. The average height is 60 to 80 feet, and diameter 15 to 20 inches. Generally used for piles, poles, fence posts, and for building purposes.

The white mangrove is likewise of the same order, but the wood is white, and the leaves are almost round. Frequently employed for building, and is much used locally for shipbuilding, furnishing "knees" that require little moulding to the necessary shape. Average size is 60 to 80 feet, and diameter 15 to 20 inches.

The mangrove grows in a peculiar manner in swamps, the seeds aerially germinating in the fruit and forming long roots dropping to the ground, eventually creating a complicated labyrinth of inter-dependent trees. Mangrove roots solidify the mud where they vegetate, and raise it, and their sanitary value is increased from the tannin yielded to the mud by the falling leaves, bark, and seeds, which is a powerful antidote against putrefaction. From its astringency the bark is in some places used for tanning, being well known to contain an abundance of tannin. All the three varieties of mangrove are employed in house building and occasionally in cabinet work.

65. MANNIBALLI, from the Moraballi creek, Essequibo river. It grows in dry situations, tall and straight, to an average height of 100 feet, with a very small top; it can be had to square 20 inches, free of sap. The wood is most durable when free of sap, and is superior to greenheart where small sizes are required. It is closed grained, and of a brownish yellow colour, and produces a sticky yellow gum.

66. MASTIC, or Gommier, or gum tree (*Busera gummiifera*). Found in Jamaica, Trinidad, St. Lucia, Dominica, etc. There are four varieties of this tree quite distinct from each other, namely, the Gommier blanc, Gommier gris, Gommier Pencens, and the Gommier maudit. One of the largest trees in the islands, with a buttressed base, and 3 to 6 feet diameter. The two former kinds are the largest, and are made into native pirogues, or dugout canoes, by hollowing out the trunk.

The gommier Pencens, or Incense tree, produces a whitish fragrant gum, which exudes on the slightest scratch and is burnt as incense in the Roman Catholic churches, and used as a

disinfectant. This resin is likewise wrapped in leaves of the balisier and made into torches or flambeaux, and is employed as a substitute for gum-mastic in making varnishes.

The gommier mandit is grown as fences, as it lives for an indefinite period, while the gum is serviceable as a plaster.

67. MORA (*Mora excelsa*). This tree comes from the Issororo creek, Upper Pomeroon river, British Guiana, and from Trinidad. It grows luxuriantly on sand-reefs and barren clays of the coast regions, reaching 130 to 150 feet in height, and squaring 18 to 20 inches. It often attains a height of nearly 200 feet; but in such cases has generally a hollow trunk. For market form the logs are 18 to 35 feet long, and 12 to 20 inches square. It can even be had to square 24 inches, free from sap and holes. There are three sorts, known as Red Mora, White Mora, and Morabucquia. The first two grow in swamps and near the rivers and creeks, and are both very durable woods. Morabucquia on the contrary grows in high situations in clayey rocky soil, and is not a durable wood. Mora is of a chestnut-brown colour, hard, heavy, tough, strong, and generally straight in the grain, but has occasionally a twist or waviness in the fibre, which imparts to the logs possessing it a beautifully figured appearance, giving to them much additional value. It is very close grained, and its exceeding toughness makes it most difficult to split. When clear of sap it is very durable, whether in or out of water, and has never been known to be attacked by dry rot. By competent authorities it is considered to be superior to oak, and to vie in every respect with teak. As it takes a good polish it would be useful as a substitute for rosewood or dark Spanish mahogany in cabinet-making, and might be employed for many purposes in the domestic arts. The economical uses of mora are somewhat restricted by the frequency of star-shake in the logs, and only the best trees can be advantageously converted into planks and boards; it may however, be used with greater profit for beams, keelsons, knees, engine bearers, etc., in shipbuilding, and in a general way in large scantlings for either civil or naval architecture. Mora possess great strength, and is one of the eight first-class woods at Lloyds. It contains an oily or glutinous substance in its pores, which is probably conducive to its durability. Weight, 65 lb. per foot cube. Crushing strength, 5.33 tons per square inch. The bark is used for tanning, and medicinally in cases of dysentery. The seeds are employed by the Indians to make a kind of meal, which is mixed with their cassava. Mora grows to a greater size, and is more plentiful at the Barima river than in any other part of British Guiana.

68. OLIVIER (*Bacida Buteras*). Found in Trinidad, Dominica, etc. A large tree, 30 to 50 feet high, which grows very rapidly, and reaches 2 to 4 feet diameter. The timber is valuable, being used for boards, planks, and all kinds of work inside and

out. It is very durable in water, and excellent for shingles. The wood is difficult to ignite, and does not flame. Value, about £8 per ton.

69. OOLU, from the Itoori-bisci creek, Essequibo river, where it grows plentifully in loose sandy soil. The wood has a strong aromatic scent, is of the colour of pale cedar, and should be useful for drawers and shelves of wardrobes. The average height is 90 feet, and it can be had to square 16 to 18 inches. Oolu produces a gum which is burnt as incense.

70. ORANGE TREE (*Citrus Aurantium*). Found in all the islands. A comparatively small tree, bearing the well-known sweet fruit. The wood is very tough, and can be utilized as handles for axes, hatches, and other tools. The flowers, leaves, and young shoots yield an oil employed in the preparation of perfumery.

71. PAKOORIE, from the Itoori-bisci creek, Essequibo river, where it thrives best in loose sandy soil. The average height is 80 feet, and it is a tree the trunk of which is very large compared with its height, squaring 36 inches, free of sap. When arrived at maturity this is a very durable wood, and is used for house-framing and many other purposes. The tree produces an edible fruit of the size and colour of a large orange, and a yellow sappy gum that is considered valueless.

72. PIMENTO (*Pimenta vulgaris*). Found in Jamaica, Trinidad, St. Lucia, etc. Also called Allspice, Baywood, and Jamaica Pepper. This tree is a species of myrtle, and grows to a height of 50 feet and 20 inches diameter, with a smooth brown trunk and shining green leaves, like those of the Bay. Obtainable in barks, 20 feet by 12 inches by 12 inches. There are two kinds of the wood, black and red, and it is employed for posts, fences, sleepers, and for naves and felloes of wheels. It is also sent home for umbrella and walking sticks. The number of pimento sticks exported from St. Lucia reaches 35,000 per annum. Bay rum is distilled from the leaves, which have a strong pleasant smell, and the berries are known as a spice and converted into a liqueur. Oil of pimento is obtained by distillation from the fruits.

73. POUI, black or ebony (*Tecoma serratifolia*). Grows abundantly in Trinidad, and is one of the hardest and most durable woods in the colony. There are two other colours, grey and green. The height is from 30 to 50 feet, and 2 to 3 feet diameter. The wood is used for posts, etc., has a peculiar odour, and takes a fine polish. Value is about £10 per ton.

74. PURPLE-HEART (*Copaifera Martii*), comes from Trinidad, and the Pomeroon river, British Guiana. There are two kinds—Koorooboorelli and Marawinaroo. The bark of the latter (which is not so durable, and is a more sappy wood than the former) is

used by the Indians for making canoes, or "woodskins." These are sometimes of large size, accommodating 15 or 16 persons. Purple-heart is one of the tallest forest trees, and has an average height of 120 feet. There are many of the trees even 200 feet high, and they can be had to square 30 inches, free of sap. The wood is of a deep blue purple colour, exceedingly pretty, hard, close-grained, durable, and tough. It is durable for ornamental furniture, cabinets, wooden tea-trays, etc., and is adapted for house-framing, mill-beds, and other structural purposes, on account of its resistance to great strains. Weight, 63 lb. per foot cube. £12 per ton have been obtained for purple-heart when exported to the United States; usual value £10 per ton.

75. PRUNE TREE (*Prunus Occidentalis*). Native of the West Indies, Guatemala, and Panama. A high tree, growing to 3 feet diameter, with the well-known fruit. The wood is of a red colour, resembling cedar, and is very hard and durable. It takes a fine polish, and makes beautiful flooring; also lasts well in water, and is good for piles. From the kernels an excellent liqueur is prepared. Weight, 66 lb. per foot cube. Crushing strength, 3.43 tons per square inch.

76. RED CEDAR (*Juniperus Virginiana*). Found in a great many of the islands. A light, but dense, fine grained wood, obtainable in scantlings up to 12 inches by 12 inches. The heartwood is reddish-brown, the sapwood is white, straight grained and porous. It is easily worked, shrinks little, and is durable when well ventilated. Useful for joinery and boarding, and has a pleasant smell. Pencils being made of it, it is styled "Pencil Cedar." The tree grows in rocky soils and in dry situations, and is closely related to the Bermuda cedar (*Juniperus Bermudiana*).

There is also a Red Cedar (*Icica altissima*), which comes from the Issorooro creek, Upper Pomeroon river, British Guiana. This tree averages 100 feet in height, and can be had 40 inches diameter; it generally grows in low situations in clay soils. The wood is most valuable and very serviceable, and has little sap.

77. ROSEWOOD (*Dalbergia sp.*). Found in British Honduras, St. Lucia, etc. A tree 30 to 50 feet high, and 3 feet diameter, with well-known rosy and dark brown coloured wood. Very valuable for all kinds of housework, furniture, and cabinet-making, as it is exceedingly ornamental and takes a good polish. Weight, 74 lb. per foot cube. Crushing strength, 5.71 tons per square inch. Owing to its weight it is difficult to transport by water, being heavier. About 200 tons are exported annually from British Honduras. Ziricote is a description of Rosewood, also from Honduras.

78. SANTA MARIA (*Calophyllum calaba*). Found in British Honduras, Jamaica, etc. An important forest tree, yielding

second-class timber. The height is as much as 150 feet, straight as a ship's mast, and up to 4 feet diameter. The wood is very abundant and on that account much used for building, although it is not considered durable. It is suitable for heavy machine work, and unsurpassed for shipbuilding. Shingles of an inferior class are split from it, the wood being hard. The seeds abundantly yield an oil for lamps.

79. **SAPODILLA**, Naseberry, or Bullet tree (*Achras Sapota*). Found in nearly all the islands. A tall fruit tree, with few branches and dark green shining leaves. It grows as much as 30 inches diameter and 100 feet high. The wood is heavy, hard, durable, and dark red in colour. There are two varieties, black and red. Adapted for inside house work, cabinet-making, and furniture, but difficult to work on account of its extreme hardness. Weight, 74 lb. per foot cube. Crushing strength, 4.30 tons per square inch. The bark and seeds have medicinal properties. Owing to the great weight of the wood the logs cannot be floated down the rivers to the ports. If this difficulty of transportation is overcome, say by the introduction of railways, the wood must find its way to European and other markets in much larger shipments than is now the case.

80. **SATINWOOD**, WEST INDIAN (*Fagara flava*, Kr. and Urb.). Found in British Honduras, Dominica, St. Lucia. Called satinwood from its lustrous surface, but in Dominica it is named Yellow Sanders, or Noyer. The tree is comparatively small, about 30 feet high and 2 feet diameter, but produces a fine hard wood, with agreeable smell, and showing on its polished surface a beautifully rippled pattern. It is of a lemon colour, very pretty, and is durable in the ground. Great favourite for veneering, panels, cabinet work, and furniture, but can only be procured in lengths up to 20 feet. Weight, 60 lb. per foot cube. Crushing strength, 4.31 tons per square inch. It is worth £6 to £7 a ton, in squared logs, in the London market. Satinwood is reported to be plentiful in British Honduras, but is getting scarce in St. Lucia.

81. **SEASIDE GRAPE** (*Coccoloba uvifera*.) Found in Jamaica; Trinidad, St. Lucia, etc. A crooked tree about 2 feet diameter, the timber of which is chiefly used for boat-building, as in the ribs of canoes. In Honduras it grows into a large tree. The leaves are very large and interspersed with red veins. The wood is hard, takes a fine polish, and may be employed for fancy work. It yields an astringent extract, and the fruit grows in clusters like small grapes. Weight, 65 lb. per foot cube. Crushing strength, 2.51 tons per square inch.

82. **SEEBADANI**, from the Moraballi creek, Essequibo river. This tree grows in clay and sandy soil, and has an average height of 90 feet. The wood is used for framing purposes, and can be had in large quantities; it will square up to 20 inches, and has very little sap.

83. **SIMARUBÁ**, Bitter Ash, or Quassia (*Quassia amara*). Found in Jamaica, Trinidad, St. Lucia, etc. Called Maruba in Grenada. A lofty tree up to 60 feet and 3 to 4 feet diameter, found in the deep forest. The wood is bitter, and will not be touched by white ants or other destructive insects; hence it is liked for inside work, boards, etc. The tree likewise furnishes the quassia or bitter wood of the chemists, from which cups are made for holding water to produce a tonic draught. The bark is known as the drug quassia, containing quassine, which is sometimes employed as a substitute for quinine. This bark was a famous Carib remedy for dysentery.

84. **SIMARUPA** (*Simaruba officinalis*), from the Itoori-hisci creek, Essequibo river. It is plentiful throughout the colony, and grows to a large size on sandy soil and on islands in the river. The average height of the tree is 90 feet, and it will square 24 inches. The wood is of a light colour, light and close-grained, and is one of the most useful for partition boards and other inside house work. Wood-ants will not eat or injure it. The bark of the root is used medicinally in case of diarrhoea. Simarupa appears to be another variety of Simaruba.

85. **SIRIS TREE**, or Woman's Tongue (*Albizzia Lebbek*, *Benth.*) Found chiefly in Jamaica. The wood seasons, works, and polishes well, and is fairly durable. It is used for furniture, boats, sugar-cane crushers, oil mills, picture frames, etc. Weighs 40 to 60 lb. per foot cube. The leaves are said to be useful in ophthalmia, while the seeds are astringent and the oil extracted from them is useful in leprosy. The bark is applied to injuries to the eye, and is employed in tanning. The gum is used to adulterate gum arabic in calico printing, and in the preparation of gold and silver leaf cloths.

86. **SOAP BERRY**, or Savonnette (*Pithecolobium miera-denium*). Found in most islands. There are two kinds—the Yellow Savonnette (or little leaf), and the Gray Savonnette (or large leaf). The berries and leaves, on account of their peculiar saponaceous matter, are used in washing, by pounding and rubbing on clothes, the word savonnette indicating a "washball." The seeds also possess medicinal properties.

The yellow savonnette is a big tree, seldom found in the interior. The wood is of a light brownish colour, employed for furniture, yokes, naves, felloes and boards. Weight 60 lb. per foot cube.

The gray savonnette is twice the size of the former, and rarely found near the sea. It is used for naves and felloes of wheels. Weight, 54 lb. per foot cube.

87. **TAMARIND** (*Tamarindus Indica*). Grows almost every where in the tropics, including the West Indies. It is a large tree, common on open plains. The wood is heavy, tough, and

elastic, of a yellowish-white colour, with irregular blotches of purplish-brown heartwood. It is very hard and difficult to work, and is applicable for turnery, handles of axes, hoes, and other tools. Transverse breaking strain--6.68 cwt., of a piece 1 inch square and 12 inches bearing. The fruits have an acrid taste, and are made into a preserve.

88. TAWARONERO, or Bastard Bullet tree (*Humirium floribundum*). This tree is plentiful in British Guiana, and grows on sandy soil and near swamps, but not in them. The average height is 90 feet, and it can be had to square 20 inches free of sap. The timber is useful for framing houses, wheel-spokes, and many other purposes, and where small-sized timber is required it is superior to greenheart. The tree produces an edible fruit about the size of a grape. At the expiration of a week or ten days after cutting away the bark from the stem of these trees, a minute fungus, emitting an agreeable perfume, grows upon them. This is scraped off and used by the Indians for scenting their hair-oil. Tawaronero produces a gum similar to bullet tree, but in much smaller quantity.

89. WADADURI, or Monkey pot (*Lecythis grandiflora*), from the Moraballi creek, Essequibo river. There are two varieties of this tree, plentiful throughout British Guiana, distinguished by the size of their leaves and the places where they grow. The small-leaved kind grows to a large size on sand and clayey soil, and attains to an average height of 100 feet. It can be had to square 28 inches free of sap. The broad-leaved sort grows in swampy places, and is a much smaller tree; its wood is not so durable as the small-leaved variety. It is used for furniture, house-building, etc., and formerly for hoghead staves. The tree bears a nut which is sometimes eaten, and a fine oil can be extracted from the kernels.

90. WAIBAIMA, from the Moraballi creek, Essequibo. This tree is a species of Cirouaballi or Siruaballi (*Nectandra*, or *Oreodaphne*). It is numerous about the Essequibo and Demerara rivers. The average height is 90 feet, and as there is little or no sap, the timber can be had to square 20 to 28 inches. The wood has a strong aromatic scent and bitter taste, and is about the best wood in the colony for planking vessels. For planking and all other purposes of shipbuilding for which greenheart is used, this wood is superior, and deserves to be classed among the first-class woods at Lloyd's.

91. WALLABA (*Eperua falcata*), from the Moraballi creek, Essequibo river. The tree grows in loose, sandy soil, over extensive tracts of country, and is well-known to every one in British Guiana. There are four varieties, two of which are never used. From the others frames for houses are made, vat staves, paling staves, and especially shingles, both for colonial use and for export to the neighbouring colonies. Wallaba wood is of a deep red colour, hard and heavy, and, being impregnated with a

resinous oil, it is very durable in wet situations; hence its value for shingles. These trees are all plentiful, and have an average height of 80 feet, and can be had to square 20 inches free of sap. The scraped root of the Itoori wallaba is used by the Indians as a cure for toothache.

92. WAMARA, from the same locality, but is more plentiful above the rapids of the Essequibo river than below. It grows on sandy soil, and averages 60 feet in height, and squares 12 inches free of sap. The heart is exceedingly hard, heavy, and very close-grained, resembling ebony. The sap wood, of which there is very little, is of a yellowish-white colour; on exposure to the weather it rots away from the heart rapidly. The Indians make their clubs from this wood. It is little used in the colony owing to its extreme hardness, but it is a fine wood for inlaying and other cabinet work.

93. WEST INDIAN CEDAR (*Cedrela odorata*). This tree is a native chiefly of Honduras, Cuba, and Jamaica, having a stem about 80 feet high and 4 feet diameter, or even 6 feet in the open. It is quick-growing, with vertical branches, the wood being dark, red or brown, fissile, opened-grained, but soft and porous. It is slightly absorbent of water, and has a sweet, peculiar smell. Used for joinery, furniture, planks, and shingles. This cedar is most suited for wardrobes, as its odour repels moths and other insects; also considered the best wood for manufacturing cigar boxes. Weight, 36 lb. per foot cube. Crushing strength, 2.94 tons. Cedrela wood-oil is obtained from this tree, and the bark yields a gum resembling gum arabic, got by making incisions. It must not be confounded with the true cedars, which are cone-bearing trees inhabiting temperate regions. About 150,000 feet are annually exported from British Honduras, and the logs are 3 to 4 feet square.

94. WHISTLING PINE (*Casuarina equisetifolia*). Found in Jamaica, Trinidad, St. Lucia, etc. Also called Horsetail tree, from its likeness to a gigantic horsetail, and is a naturalised beefwood tree from Australia. In St. Lucia it is termed Filaro, which is probably the patois corruption for the French *filardeau*, a sapling—a reference that may be justified by the light appearance of the tree. The whistling pine is tall, straight, and slender, with a diameter of 12 to 18 inches, and growing to 60 or 80 feet high. It has the appearance of a fir, with small feathery branches, and from its sombre look it is sometimes planted in cemeteries. The wood is red colour, resembling beef, and is extremely hard, tough, durable, and adapted for scaffold posts and masts; being heavy it is valued for steam-engines, etc. Seems to coppice well, and is an important tree for fuel. The bark is astringent, and is useful in diarrhoea and dysentery.

95. WHITE CEDAR (*Myristica* sp.), from the Itoori-bisci creek, Essequibo river, and also from Trinidad, St. Lucia, etc.; is called Warikuri in British Guiana, and Poirer in St. Lucia. It

grows plentifully in wet places, especially in the swamps up the Lamaha canal, leading into Georgetown, Demerara. The height is about 60 feet, with buttressed base, the diameter being 6 feet in the forest, but the ordinary section is 12 to 18 inches. The wood is white, has a pleasant smell, and is of pretty texture. It is hard, heavy, and close-grained, very durable under ground, but splits on exposure to the sun. It is well suited for piles, foundations, posts, jetties, and for any water work; and makes good yokes, boards, and shingles, and has proved to be especially suited for piles, as, if the portion between high and low water be protected, the wood will last in sea-water a long time; in this respect it is more durable than greenheart. The logs, however, are difficult to get quite straight. Piles can be had up to 40 feet long, and 10 inches diameter. Though white cedar lasts well in outside work or when wholly immersed in water, it will not withstand moist places, such as at the junction of the ground and air or between wind and water. Weight, 50 lb. per foot cube. The ashes of the bark are employed by the Caribs as a cure for dropsy.

96. WILD GUAVA, from the upper Essequibo river. The tree grows best in rocky soil, and there are four varieties. The wood is little known, but where a light, tough, and close-grained timber is desirable, wild guava should answer admirably. Its average height is 60 feet, and it will square 10 inches. The bark is a powerful astringent.

97. YACCA (*Podocarpus coriaceus*). Found in Jamaica, on the Blue Mountains. The tree is about 50 feet high and 18 inches diameter, the wood being highly prized and ornamental, and much used in furniture and cabinet work. The planks are beautifully marked, and are employed in the interior finishings of dwelling-houses. Weight, 47 lb. per foot cube. Crushing strength, 2.55 tons per square inch.

98. YELLOW CIRQUABALLI, or Sirua-balli, from the Arouapia-kooroo creek, Pomeroon river, British Guiana. The tree grows to a large size in loose sandy soil, but it is difficult to procure over 12 inches square free of sap; the average height is 60 feet. The wood is light, of a bright yellow colour, and strong aromatic scent, and is used principally for planking boats; when free of sap it is most durable. The bark is useful for tanning.

99. YELLOW SANDERS, or Yellow Wood (*Xanthoxylum clava Herculis*), is found in most of the islands. It is called Prickly Yellow in Jamaica, and Yellow Hercules in Grenada. There are two kinds, known by the colour of the bark—the black and the brown (this latter is sometimes mistakenly called white). The black has short prickles and thick dark leaves, while the brown has very pointed prickles and light green-yellow leaves. It might therefore be termed Prickly tree, the French appellation, of L'Épineux, by which it is known in St. Lucia, signifying

"thorny." The tree is about 50 feet high, and logs can be had a foot square. The wood is of a light yellow colour, of fine and even grain, and is employed for furniture, house work, fence posts, and almost every purpose. It is not considered durable for outside work. The wood with the black bark is superior. Weight, 52 lb. per foot cube. Crushing strength, 1·77 tons per square inch. The bark is considered a powerful stimulant and febrifuge; it is likewise used as a cure for rheumatism.

There is also another Yellow Sanders (*Bucida capitata*), alternatively named Wild Olive, or Negresse. This tree is 30 to 60 feet high and up to 4 feet diameter, with roundish leaves. The wood is of a light yellow colour with satin graining, and is much prized in cabinet work, where it sets off dark woods. It saws freely, makes a beautiful board, and takes a high polish.

100. YOKE WOOD, Mast Wood, or French Oak (*Catalpa longissima*), a native of Hayti, Jamaica, Trinidad, St. Thomas, etc. It is a tall, handsome tree, about 80 feet high, and 3 feet diameter, and is rarely found above an elevation of a thousand feet. The wood is light brownish-grey, with cross stripes of a darker colour, and somewhat resembles walnut. It is one of the most useful and best of timbers for boards and scantlings, very durable, and not too hard for general purposes. Weight, 70 lb. per foot cube. Crushing strength, 2·09 tons per square inch.

REFERENCES.—Specimens of West Indian woods were sent to the Colonial and Indian Exhibition of 1886, and were then permanently housed in the Imperial Institute, where they may now be seen. Lists of many Colonial woods appeared in the handbook of that Exhibition. A large catalogue with the names of 169 trees of Dominica, was compiled by the late Dr. John Inray of that Island, and appeared in the *Technologist* of June, 1862; the samples which accompanied it are now in the Kew Museum. This collection was sent to the great Exhibition of 1862, and obtained the award of a bronze medal. A good catalogue of 63 woods of British Guiana was likewise prepared by Mr. Michael McTurk for the Local and Paris International Exhibitions of 1878. A list of 75 trees of St. Lucia, with full descriptions and uses, was compiled by the present author as a portion of his book on "Building in St. Lucia," published in 1898.

The following references may be useful to those who would like additional information :—

Journal of the Institute of Jamaica for July, 1896. Price, 1s. The London agents are H. Sotheran and Co., 140 Strand, W.C. This issue of the foregoing journal gives a summary of tests of 22 specimens of Jamaican timbers sent to the Imperial Institute, with some useful remarks.

Economic Plants, being an Index to the Economic Products of the vegetable kingdom in Jamaica. By Wm. Fawcett, B.Sc., F.L.S., Director of Public Gardens, Jamaica. Published in 1891, from the Government Printing Establishment, 79 Duke-Street, Kingston, Jamaica. This pamphlet gives good and full descriptions of many Jamaican trees.

The timbers of Jamaica, by Hon. W. B. Escent. A paper published by the Institute of Jamaica, in 1881. Price, 6d. London agents, H. Sotheran and Co., 140 Strand.

Jamaica at the Royal Jubilee Exhibition, Liverpool, 1887. By C. Washington Eves. Spottiswoode and Co., London. A book with 91 pages.

Report on Forest Conservation for Trinidad, by J. H. Hart, F.L.S., May 1891. Waterlow and Sons, London.

The Colony of British Honduras, by D. Morris, M.A., E. Stanford, 55, Charing-cross, London.

Building in St. Lucia, by J. T. REA, F.S.I., M.R.I.A.I., Surveyor, War Department. Published in 1898 by R. Carruthers & Sons, Courier Office, Inverness. Price, 2s. 6d. Contains full descriptions and uses of 75 trees of St. Lucia.

Handbooks of the various West Indian Colonies, published locally.

Various other compilations on West Indian timbers have been made, but these are little known and not always easy to obtain.

A Forest Officer and a Sportsman.

The following is a cutting from the *Morning Post*:—

"AN Indian Forest Officer, at present on furlough in England, is in exceptional position to OFFER prospects of large and small GAME SHOOTING to One or Two Gentlemen on his return; references indispensable: communications strictly confidential.—Address Tectonā, 796, "Morning Post" office, Strand, W.C."

To say the least of it, I think it will hardly commend itself to most Forest Officers.

I. F. S.

[We would draw advertiser's attention to Section 74 of the Indian Forest Act.—Hon. Ed.]

Manual of Indian Timbers.

WE understand that the new edition of Mr. Gamble's *Manual of Indian Timbers* will be published during this month by Messrs. Sampson Low, Marston & Co., Fetter Lane, London, E.C. The price of the volume is 18s., and it can be procured from the publishers.